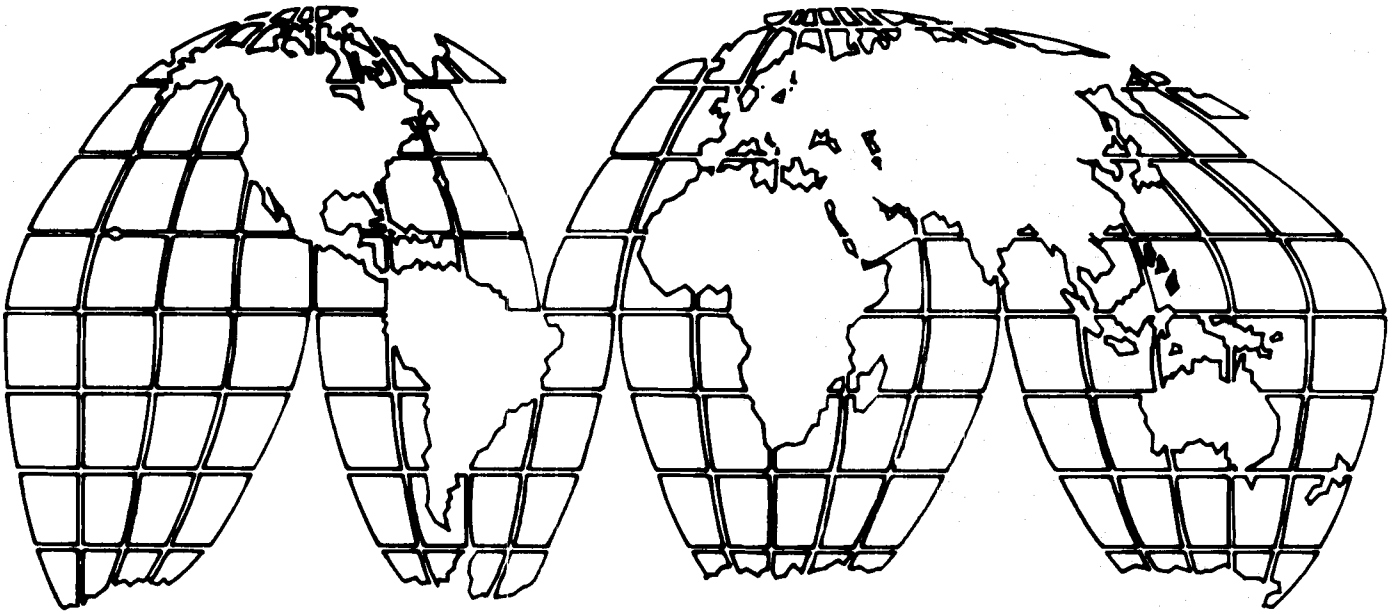
A.I.D. Evaluation Special Study No. 26

Promoting the Manufacture and Use of Small-Scale Agricultural Machinery in Indonesia



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BEST AVAILABLE

PROMOTING THE MANUFACTURE AND USE OF SMALL-SCALE AGRICULTURAL MACHINERY IN INDONESIA

AID SPECIAL STUDY NO. 26

by

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FOREWORD

This study is one in a series undertaken by the Center for Development Information and Evaluation, Bureau for Program and Policy Coordination, to examine AID experience with the implementation of the Private Sector Development Initiative since 1981.

The other related papers in the series are as follows:

A.I.D. Program Evaluation Report No. 14, (PN-AAL-049) A Review of AID's Experience in Private Sector Development, April 1985

A.I.D. Evaluation Special Study No. 23, (PN-AAL-047) Private Sector Development in the Thai Seed Industry, June 1985

A.I.D. Evaluation Special Study No. 24, (PN-AAL-050) Management Education in Modern Tunisia: L'Institut, Superieur De Gestion, Tunis, April 1985

A.I.D. Evaluation Special Study No. 25, (PN-AAL-051) Ecuador Industrial Development Finance, June 1985

A.I.D. Evaluation Special Study No. 29, (PN-AAL-054) Private Development Corporation in the Philippines, Summer 1985

We are indebted to the authors of these papers for their contributions to AID's understanding of the role of the private sector in development, and of the Agency's role in that development.

W. Haven North
Associate Assistant Administrator
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ACKNOWLEDGMENTS

Over a 4-week period during January and February 1984, the team visited more than 20 manufacturers and Government workshops throughout Sumatra and Java, as well as two fabricators in the Philippines. Site visits were supplemented by meetings with a large number of key informants. Covering so much ground in so short a time was made possible by the unusual level of support provided to the team by the Government of Indonesia, the USAID Mission in Jakarta, and the International Rice Research Institute (IRRI) in Los Banos, Philippines.

In particular, we are grateful to Ir. R. Dadang Tarmana and Ir. Buhari Gultom of the Government's Subdirectorate for Agricultural Mechanization, who accompanied us throughout our travels in Indonesia. In the Philippines, Clarence Bockup, Bart Duff, and Amir Khan, all of the IRRI Engineering Department, interrupted their annual review meeting to brief us, and Robert Stickney made it possible for us to see two Filipino manufacturers. V.R. Reddy, the IRRI adviser in Indonesia, met with the team in Los Banos and then accompanied us on our travels, giving generously of his time. Finally, several members of the USAID/ Jakarta Mission were particularly helpful in guiding our inquiry, including Tim Mahoney, Terry Meyers, Ken Prussner, and especially Kevin Rushing, who also did an excellent job of arranging for our travel throughout Indonesia.

Without their contributions, this study would not have been possible. We trust they will find it informative.

SUMMARY

Early Agency for International Development (AID) support to the International Rice Research Institute (IRRI) enabled it to develop improved rice varieties, with the promise of expanding yields throughout Asia and other parts of the less developed world. Somewhat later, IRRI turned its attention to promoting more efficient cultivation practices through the development of better tools and simple machines that would help increase yields, reduce losses, and permit multiple cropping, especially in labor-shortage areas. In much the same way that agricultural extension programs have proved necessary for gaining acceptance for new farm inputs and practices, it soon became apparent that an industrial extension effort was needed to promote the development of a rural, small-scale, private sector industry to manufacture, distribute, and service these machines and implements, as well as to promote their use among the farmers of Asia. Since the late 1960s, AID has provided support for this effort in Indonesia and elsewhere through the Industrial Extension of Small-Scale Agricultural Equipment Project (498-0265).

In January-February 1984, a four-person team spent 4 weeks assessing the effectiveness of the IRRI-Indonesian approach to promoting the manufacture and use of small-scale agricultural machinery in selected rice growing areas. The team began its inquiry in the Philippines where it visited IRRI and several Filipino manufacturers of IRRI-type machinery. The team then traveled to Indonesia, where it concentrated its study in Sumatra and, to a lesser extent, West and Central Java. The team focused on the IRRI-Indonesian intensive effort to extend manufacturing technologies for small-scale agricultural machinery to small workshops, as well as on the effort to stimulate demand through demonstrations and other agricultural extension activities. In the course of this assessment, the team found that the manufacture and use of the technology is spreading beyond the target areas, as other workshops and farmers come into contact with the machines independently of the formal extension effort.

It is too early to evaluate the long-term viability and broad impact of these new manufacturing ventures, because many have begun production of the IRRI-type machines only recently and most operate on a very small scale. By the same token, the machines have not been used by Indonesian rice farmers for very long. Finally, the sample of both manufacturers and users is still very small. Therefore, our findings about direct socioeconomic benefits of this particular industrial extension effort (e.g., increased income, expanded rural off-farm employment, production linkages) are inconclusive. (The indirect benefits--for

instance, increased rice production and reduced postharvest losses--are the subject of another study.[1])

A very important outcome of the IRRI-Indonesian activity is a function not only of the industrial extension effort itself but of the complementary effort to influence Indonesian policy regarding the importation of agricultural machinery. Initial resistance to the introduction of the local manufacture of IRRI-type equipment was a direct result of an earlier unsuccessful effort to introduce larger, imported machinery that proved poorly suited to Indonesian farming conditions and impossible to maintain. As a result of the current IRRI-Indonesian effort, both the Indonesian Government and some elements of the private sector now believe that a locally manufactured product can do the job. Locally manufactured farm machinery has proved feasible; it is less costly and easier to maintain and repair than imported machinery. The policy environment (including recent bans on imports and greater availability of credit to both manufacturers and buyers of small-scale machinery) is now more favorable to local, private manufacturers. This import-substitution lesson could carry over into postharvest machinery manufacture, as well as into locally manufactured rural transport technologies.

It is possible to draw preliminary conclusions about the nature and effectiveness of the IRRI-Indonesian approach to promoting both the manufacture and the use of small-scale machinery in labor-shortage areas. The level of technology being transferred is easily adopted by small-scale manufacturers, because it requires little capital or equipment for fabrication and it relies on skills already present in many rural workshops. Local fabrication of the IRRI-type equipment has been started successfully by firms that vary in size, market orientation, and commitment to sustained small-scale agricultural machinery manufacture. The IRRI-Indonesian technical assistance effort has capitalized successfully on the different characteristics of various potential manufacturers. Initially, the technology was introduced by intensive promotion of its manufacture by large, established workshops employing workers of sufficient skill levels to assure a reliable supply of acceptable prototypes. To these firms the manufacture of IRRI-type machinery is strictly a sideline. Larger scale production has been undertaken by other manufacturers who are assured of substantial Government orders. Sustained commitment to the manufacture and promotion of the

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[1]The results of a 1977 AID-funded research project, The Consequences of Small Farm Mechanization on Production, Income, and Rural Employment in Selected Countries of Asia, were published by IRRI in Consequences of Small-Farm Mechanization (Los Banos, Philippines: IRRI, 1983).

machinery, however, is characteristic only of the smaller fabricators with a direct link to farmers. For these family businesses, especially for the genuine entrepreneurs among them, the manufacture of IRRI-type machinery is now a significant and growing element of their livelihood.

It seems safe to venture that this approach to transferring a manufacturing technology to small-scale, private sector fabricators is replicable in other Indonesian provinces and, with some modifications, in other developing countries. Important considerations are (1) the conduciveness of the policy environment and (2) the baseline level of rural metal fabrication and the sophistication of the fabrication process, assuming the equipment is appropriate for the mechanization needs of the area. The team is less optimistic, however, about the replicability of this approach for technology transfer to nonagricultural manufacturing. The small-scale agricultural machinery subsector is both a manufacturing industry (fabrication, including technology adaptation) and a service industry (repairs, overhauls, custom-hire operations). Because of this critical linkage and the requirement that the equipment be modified to meet local conditions, the arguments for a dispersed, small-scale agricultural machinery industry outweigh the countervailing argument for greater economies of scale offered by more concentrated production. Thus, the team is hesitant to endorse the IRRI-Indonesian approach to promoting the manufacture and use of agricultural machinery as a general approach for promoting the development of small-scale industry, because fabrication and service are not generally as closely linked or dependent on local adaptation as is agricultural machinery.

Much of the success of the IRRI-Indonesian effort stems from the enormous enthusiasm and dedication of the IRRI project officer, V.R. Reddy, and his Indonesian counterparts. There is ample evidence that the technology transfer to the private sector is effective, particularly in the West Sumatra target area, because of the intensity of these change agents' efforts. However, the importance of a few key personalities working on a one-to-one basis with both fabricators and farmers creates doubts about its replicability on a broader scale. Nonetheless, given more time to observe the extensive and reactive technology transfer and spontaneous technology adoption that are occurring alongside the intensive effort, it may become evident that the Indonesian approach is, indeed, widely applicable.

GLOSSARY

AARD	- Agency for Agricultural Research and Development
AID	- Agency for International Development
ALSINTANI	- Indonesian Agricultural Machinery Association
BANPRES	- Presidential Aid
BAPPEDA	- Provincial Planning Agencies
BAPPENAS	- Indonesian National Planning Agency
Bapak Angkat	- Ministry of Industry Foster Parent Program
BI	- Bank Indonesia
BIMAS	- Rural Credit Program
BIPIK	- MI Industrial Extension Program
BKK	- Central Java Provincial Credit Program
BNI '46	- Bank Negara Indonesia 1946
BRI	- Bank Rakyat Indonesia
Diperta	- Provincial Agricultural Extension Program
DITPROD	- Directorate for Food Crop Production, Ministry of Agriculture
FAO	- United Nations Food and Agriculture Organization
GOI	- Government of Indonesia
IBRD	- World Bank
ICRISAT	- International Center for Research in Semi-Arid Tropics
IRRI	- International Rice Research Institute
Kabupaten	- District level of local government
KIK	- Small Investment Credit Program
KMKP	- Small Permanent Working Capital Credit
KUPEDES	- General Rural Credit Program

LIK	- Mini-industrial estates
MIDC	- Metal Industry Development Center
pribumi	- Indigenous Indonesians
Repelita III	- Third Five-Year Development Plan, 1979/1980 - 1983/1984
Repelita IV	- Fourth Five-Year Development Plan, 1984/1985 - 1988/1989
RNAM	- Regional Network for Agricultural Machinery
Rp.	- Rupiah (US$1 = Rp992 as of February 1984)
RPMU	- Regional Project Management Unit
UNDP	- United Nations Development Program
UNIDO	- United Nations Industrial Development Organization
USAID/Jakarta	- USAID Mission to Jakarta

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1. PURPOSE AND KEY ISSUES

1.1 Study Purpose

This Special Study focuses on efforts of the Government of Indonesia (GOI), with Agency for International Development (AID) assistance, to promote the development of a small-scale, private sector agricultural machinery industry. Although this study is not a project evaluation in the strict sense, our entry point is AID's Asia Bureau's Industrial Extension of Small-Scale Agricultural Equipment Project (498-0265).[1] The project provides funding through the International Rice Research Institute (IRRI) in Los Banos, the Philippines, to promote the manufacture of small-scale farm machinery in several Asian countries.

The Indonesian effort to promote the development of an indigenous, small-scale agricultural machinery industry followed a decision in the late 1970s to introduce mechanization selectively in labor-shortage areas to increase productivity and reduce post-harvest losses.[2] There has been some controversy in the past over the appropriateness of promoting mechanically powered farm machinery in the fifth most populous nation in the world and elsewhere in Asia. Accordingly, the consequences of small-scale farm mechanization were carefully examined in earlier research funded by AID.[3] Therefore, this study is not focused on the

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[1]The project countries are the Philippines, Thailand, India, and Indonesia. An earlier project, begun in 1975 by the Technical Assistance Bureau, was targeted at both Thailand and Pakistan, but the latter was dropped from the current project.

[2]Agricultural mechanization includes the use of hand tools, implements, and machines for land preparation, production, harvesting, and on-farm processing. It involves three main sources of power: human, animal, and mechanical. Mechanical power technology embraces all agricultural machinery powered by mechanical sources such as engines (A.G. Rijk, Role of Agricultural Mechanization in Asia, Staff Study Paper [Manila, the Philippines: Asian Development Bank, 1983]).

[3]In 1977 AID funded a research project, The Consequences of Small Farm Mechanization on Production, Income, and Rural Employment in Selected Countries of Asia, undertaken jointly by IRRI and the Agricultural Development Council. The research results were presented in conferences and published by IRRI in 1983 in Consequences of Small-Farm Mechanization. Two of the four field sites were in Indonesia, one in West Java, and the other in South Sulawesi. Citations to the work are included in the Bibliography.

larger technical and socioeconomic issues related to the consequences of mechanization on farm households, rural employment, agricultural productivity, or income distribution. Instead, this study examines the approach and results of efforts, funded in part by AID, to transfer manufacturing technologies to small-scale entrepreneurs and to promote the manufacture and use of appropriate machines.

1.2 The Product: Simple Farm Machinery for Small Farms

The Agricultural Engineering Department of IRRI has developed a variety of implements and tools to improve paddy cultivation. They range from a hand weeder to internal combustion-powered machines such as a grain thresher and the single-axle, two-wheel tractor, commonly known as a power tiller. The level of technological sophistication is relatively simple. (Appendix A includes photographs of several of these IRRI-type implements and machines.)

The designs were developed or adapted at IRRI-Los Banos, in the Philippines, in conjunction with its long-term effort to improve paddy yields.[4] Indonesian prices of the powered IRRI-type machinery range from approximately US$600 for the thresher with a four-to-five horsepower gasoline engine to US$2,000 for the power tiller with a six-to-eight horsepower diesel engine. Other than the engine, all the machinery can be fabricated in small workshops with light metal cutting, bending, and welding technology and a minimum of purchased components (mainly bearings, sprockets, and chains).

Although these machines are intended for small-scale rice producers, some IRRI-type machinery, implements, and components are being mass-produced in medium-to-large factories. For example, internal combustion engine manufacture, which requires precision engineering and large capital investments, clearly falls within the scope of the large-scale industrial sector (and thus is beyond the bounds of this study). IRRI's aim, however, is to promote technology that is amenable to production in dispersed, small-scale workshops and factories, for two reasons: (1) to foster innovation and facilitate maintenance by locating

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[4]The adapted designs originated in other project countries (e.g., axial flow pump and the improved animal-drawn plow from Thailand), neighboring countries (the vertical reaper from the People's Republic of China), or other international research institutes (the manual punch planter from ICRISAT in India).

manufacturers near end-users, and (2) to stimulate rural off-farm employment to offset any marginal labor displacement that may result from the decision to promote selected mechanization.

Under the project, AID has provided between US$50,000 and US$83,000 annually to the Directorate for Food Crop Production, Ministry of Agriculture (DITPROD) since 1980 in support of its adaptive research and agricultural mechanization extension effort. These funds, along with GOI counterpart funds, support local salaries, travel, workshop materials and equipment, office space, and expenses associated with field days, seminars, and training to promote both the manufacture and use of the small-scale machinery. In addition, an AID-financed expatriate IRRI engineering consultant, V.R. Reddy, has resided full-time in Indonesia since 1978.[5] With his assistance, a strategy has evolved for stimulating demand for locally made IRRI-type equipment and for identifying and technically assisting small-scale manufacturers principally in four areas: West Sumatra, West Java, South Kalimantan, and South Sulawesi. This activity is being institutionalized through training and assistance in formulating and implementing a long-range, national mechanization policy. (For a more complete description of the AID project, see Appendix B.)

1.3 Approaches to Technology Transfer To Establish Local, Private Farm Machinery Manufacture

The IRRI-DITPROD industrial extension project represents one approach to promoting technology development of a private, small-scale agricultural machinery industry. Several different patterns of government and private sector interaction in the production and use of small-scale farm machinery were observed. The team characterized these in terms of different approaches to technology transfer. The following is a brief conceptual background to the process.

We define "technology" broadly as "knowing how to do," and distinguish among three phases or levels of transfer:

1. Material Transfer. The technology is introduced (and copied) through the physical exchange of products.

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[5]USAID/Jakarta provided funds for IRRI to recruit Reddy, and some support came from the earlier project funded under the AID Technical Assistance Bureau (now Science and Technology Bureau).

2. Design Transfer. The technology is transmitted through designs, blueprints, or prototypes (models).

3. Capacity Transfer. The technology is assimilated through institutionalization of "local capacity for investigation and innovation of a continuous stream of locally adapted technology."[6]

Capacity transfer may involve field extension activities to improve technical and entrepreneurial skills eventually leading to "technological mastery"--the ability not only to adapt the technology, but also to develop new products and processes as well.[7] Clearly any industrial extension effort that aims at a self-sustaining development process should strive to achieve this last phase, or highest level, of transfer: mastery of the technology.

The IRRI-DITPROD project objective is to promote the capability of private enterprises to supply appropriate farm machinery technology for increased rice production. It aims to do this by institutionalizing a process of technology transfer from government sources to the private sector. Originally, IRRI concentrated its international expertise on the research function, that is, developing the appropriate rice production technology for use on small farms. The transfer of the technology to the farmers began simply as a matter of making the prototype machinery available to the agricultural extension services of participating countries (material transfer). Blueprints were also transmitted to agents within the countries, in some instances directly from IRRI-Los Banos staff to fabricators identified by the governments (design transfer). After several years of following this approach, however, IRRI learned that the diffusion of the technology through a prototype-blueprint approach was not adequate. Therefore, an outreach program was established to provide technical assistance to complete the transfer process, that is, to take it beyond the material and design transfer stages to capacity transfer. In this way, an IRRI two-phased strategy evolved that emphasizes the introduction and adaptation of the prototypes to the specific country settings and leaves the development of local capabilities to test, adapt, commercially manufacture,

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[6]Vujiro Hyami and Vernon W. Ruttan, Agricultural Development: An International Perspective (Baltimore, Maryland: Johns Hopkins University Press, 1971).

[7]Larry E. Westphal, Fostering Technological Mastery by Means of Selective Infant Industry Promotion, World Bank Reprint Series No. 253 (Washington, D.C.: World Bank, 1982).

distribute, and provide after-sales service to local cooperating institutions in the participating countries, (e.g., in Indonesia, the DITPROD Subdirectorate for Mechanization).

1.4 Report Overview

The evaluation has as its primary focus the impact of IRRI-DITPROD efforts on the farm machinery industry in Indonesia, in particular small-scale fabricators of IRRI-type rice-production machinery in labor-shortage target areas. Section 2 presents our findings from a 3-week field survey of roughly two dozen enterprises which we examined to assess the success of the industrial extension efforts. The industrial extension approaches are characterized as "intensive" or "extensive," depending on whether or not the location was a targeted IRRI-DITPROD project area. The DITPROD Subdirectorate for Mechanization has activities, apart from the IRRI-DITPROD program, designed to stimulate local manufacture which we describe as "extensive" (i.e., broadly targeted and diverse activities). Fabricators have responded in the targeted areas to the promoted products, and in all areas spontaneous production has been taken up by other entrepreneurs. Where this has occurred in target areas, the IRRI-DITPROD project staff have taken what we call a wait-and-see approach, which we have characterized as "reactive." Other fabrication enterprises have continued to operate completely independently of the project or Subdirectorate. We summarized these alternatives in Table 1.

Table 1. Technology Transfer Approaches and Fabricator Responses

Location of Industrial Extension	Fabricator Responses	
	Technology Transfer Actively Promoted	Technology Transfer Process Spontaneous
IRRI-DITPROD Targeted Project Areas	**Intensive**	**Reactive**
Nonproject Areas	**Extensive**	**Independent**

Section 3 analyzes the range of interventions that are promoting technological development of the agricultural machinery industry in Indonesia. This section expands on the characterization above by describing the institutions and activities associated directly with the IRRI-DITPROD industrial extension effort, as well as the independent technology transfers affecting the small-scale enterprises.

The climate affecting the viability of the small-scale fabricators described in Section 2 and the effectiveness of the technology transfer efforts described in Section 3 are important to our understanding of the context in which the IRRI-DITPROD industrial extension program operates. This policy environment for small-scale agricultural machinery manufacture is discussed briefly in Section 4. Other factors that may explain the developmental processes being observed, principally the pressure to import agricultural machinery, are also explored.

Section 5 summarizes the team's findings and presents several cross-cutting issues and conclusions that link the two intertwined themes from this evaluation: the development of small-scale agricultural machinery manufacturing enterprises in response to alternative approaches to public sector promotion of technology transfer to the private sector.

2. THE MANUFACTURERS OF SMALL-SCALE AGRICULTURAL MACHINERY

The team focused its field study on the small-scale machinery manufacturers in the IRRI-DITPROD project or target areas to observe the impact of Government efforts to promote the manufacture of appropriate rice production equipment. Previous evaluations of the IRRI outreach program had concentrated more on the project strategy and execution but had gathered little information from the fabricators themselves.[8] In view of AID's private

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[8]AID has carried out two project evaluations related to this effort. The first was in 1979/1980 and because V.R. Reddy, the IRRI adviser in Indonesia, had only been in post since 1978, it examined initial startup activities in Indonesia and West Sumatra (Garrett Argento et al., "Evaluation of IRRI Small Scale Farm Equipment Project" [Washington, D.C.: Agency for International Development, 1980] [mimeo].) The second evaluation was at the project's midpoint and explored the strategy being used in Indonesia in more depth (Garrett Argento et al., "Evaluation Report on Extension of Small Scale Agricultural Equipment [492-0265]" [Washington, D.C.: Agency for International Development, 1982] [mimeo].)

sector emphasis, we concentrated on the entrepreneurs who were exposed to the IRRI-type farm machinery technology: How did they begin? What were the enterprise's original business activities? What changes in the firms have occurred since the IRRI-DITPROD intervention began? What are their prospects for sustained production of small-scale machinery?

2.1 The Field Visits

The team visited 21 manufacturers of small-scale agricultural machinery in Indonesia.[9] They include nine fabricators in West Sumatra, four in North Sumatra, two in Aceh, four in West and Central Java, and two in Jakarta. Some are formal IRRI-DITPROD cooperators; others are not. They have received assistance ranging from an intensive to an extensive level of effort by IRRI-DITPROD or some other GOI agency.

Logistical considerations restricted our study to entrepreneurs in the main pilot area of West Sumatra, the provinces of North Sumatra, Aceh, and sites in Java (see Appendix C on methodology). Thus, although the IRRI-DITPROD program also has been active in South Kilimantan and South Sulawesi Provinces, we concentrated our limited resources on examining the main target area of IRRI-DITPROD's efforts and on firms in these areas that were not cooperators with the project (at least initially) but provided a basis for comparison with those directly participating.

We gathered information on each firm by interviewing owners or managers and by observing their facilities, capital equipment, manufacturing processes, and products. The findings are summarized and tabulated for comparison (see Tables 2 and 3). The financial and economic data are indicative only, as there was little opportunity to verify reported sales, assets, borrowing, or even number of employees. Also, there is reason to suspect some underreporting. Hence we have not attempted to characterize the firms by using analytical measures such as capital-to-labor ratios, debt-equity, net worth, or even profits and losses; rather, we present our indicative and qualitative comparisons.

In the course of pulling this information together, it became apparent that the project cooperators, and indeed small fabricators generally, fall into four groups:

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[9]In conjunction with a visit to IRRI-Los Banos, the team took the opportunity to visit several cooperating manufacturers in the Philippines, permitting comparisons to enterprises in Indonesia.

Table 2. Description of Small-Scale Machinery Fabricators: Sideline and Government-Oriented Firms

Item	Sideline Firms					Government-Oriented Firms				
Firm Identification	A	B	C	D	E	F	G	H	I	J
Location WS - West Sumatra NS - North Sumatra J - Java, Jakarta A - Aceh	WS	WS	WS	J	J	J	WS	NS	NS	A
Threshers Produced										
1981	9	2	50				-	-	-	-
1982	71	4	-				-	-	-	-
1983	100	10	-				50	36	-	13
In-Process/Unsold	3	-	-				9	100	8	17
Total	183	16	50		50		59	136	8	30
Repairs (after sales)	X	X				X	X			X
Power Tillers Produced	1			35	10	300				
IRRI Models	Prototype			10	10	-				
Other	-			25	-	Thai				
Other Agricultural Machinery	Rice Mill Corn Sheller			Pump Dryer	Trans-planter Weeder	Pump Corn Sheller Dryer	Weeder	Peanut and Corn Shellers		-
Other Products/Services	-			Steel Constr.	-	Importers	-	-		-
Other Prototypes	-			-	-	-	-	-		Dryer
Sales										
to Government	25%		50%	100%	10%	100% (4	90%	Hoped for	Hoped for	-
to Dealers	5%		-	-	40%	branches)	-	-	-	3%
to Farmers	70%	100%	50%	-	50%	-	10%	-	-	97%
Sales Area (radius)	-	-	250km	-	-	-	-	-	-	400km
Price of Thresher	-	$500	$500	-	$250 (w/o engine	-	$575	$690	$600	$650
Price of PT Tiller	$1,800	-	-	$2,500	-	$2,831	-	-	-	-
Weight	130kg				125kg			90kg	-	130kg
Capacity	-				-			400kg/hr	500kg/hr	-
Innovations	Low	Low	Low	Med	Low	High	Low	High	Low	Low
Quality	High	Med	Med	Med	Med	High	Low	Med	High	Low
Person-days To Manufacture Thresher	-	30			30			30	3	13
Low Costs	-	$60			-			-	-	-
Raw Materials	-	-			-			-	-	$235
Engine	$245	$200			-			-	-	$200

Table 2. Description of Small-Scale Machinery Fabricators: Sideline and Government-Oriented Firms (cont.)

Item	Sideline Firms					Government-Oriented Firms				
Firm Identification	A	B	C	D	E	F	G	H	I	J
Location WS - West Sumatra NS - North Sumatra J - Java, Jakarta A - Aceh	WS	WS	WS	J	J	J	WS	NS	NS	A
Total Employees	25	16	-	100	125	156	10	18	15	6
Working on Mag Machines	-	-	8	30	50	-	-	-	4	-
Wages (per day)										
Minimum	$1.50	$1.50	$2.50	$1.50	$2.00	$1.50	-	$2.00	$2.00	$2.50
Maximum	$2.50	$3.50	$3.50	$6.00	$3.50	$6.00	-	$5.00	$4.00	$3.00
Meals Included	No	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes
Year Firm Started	1956		1975	1952	1956	1979	-	1976	1979	1983
Initial Product/Service	R&M		Car Sales	Welding/ Constr.	-	Importer	Co-op	Pedal Thresher	Sprayer	Thresher
Initial No. of Employees	5		-	2	-	-	-	-	-	-
Rural/Urban Location	Urban	Urban	Urban	Urban	Urban	Urban	Rural	Urban	Urban	Urban
Plant Size (sq. m)	1,600	30	-	1,500	2,000	5,000	300	1,500	150	250
Layout Assessment	Med	-	-	-	High	High	Med	High	Med	Med
Uses Jigs/Fixtures	Yes	Low	-	-	-	Yes	No	-	Yes	Yes
Own Generator	X	X		X	X	X	X		X	
Lathes	X	X		X	X	X	X		X	
Produces										
to Order	X	X	X		X		X		X	X
to Stock	X			X		X	X	X	X	X
Owner Characteristics										
Age	55	65	60	65	45	65	65	50	37	40
Education	16yr	12yr	14yr	12yr	14yr	-	-	-	16yr	7yr
Farmer/Contractor	-	-	-	Farmer	-	-	-	-	Cntr.	-
Association Member	-	-	-	Yes	Yes	Yes	-	-	-	-
Engineers on Staff	-	-	-	-	-	Yes	-	-	-	Yes
Training										
At Province	X	X					X			X
At Jakarta Workshop	X				X					
Other									MIDC	
Technical Assistance										
Intensive	X	X	X	X	X		X			
Extensive								X	X	X
Design Source										
Copy				X		X	X	X		X
Blueprint	X	X	X	X	X		X		X	
Prototype	X		X	X	X					X
Credit										
To Firm	$30,000	Yes	Yes	Yes	-	-	No	Partner	-	No
To Customer	Yes	Yes	No	No	No	No	Yes	No	Yes	No
Perceived Constraints										
Credit				X	X	X				
Demand	X		X		X		X	X	X	
Other		Too Much Competition	Labor	Management	X	Raw Materials				

Table 3. Description of Small-Scale Machinery Fabricators: Family and "Superstar" Firms

Item	Family Firms				Superstar Firms			
Firm Identification	K	L	M	N	O	P	Q	R
Location WS - West Sumatra NS - North Sumatra J - Java, Jakarta A - Aceh	WS	WS	NS	A	WS	WS	WS	NS
Threshers Produced 1981 1982 1983 In-Process/Unsold Total Repairs (after sales)	2 6 6 - 14 X	- 3 4 - 7 X	- - 50 - 50 X	- - - 27 27	3 30 70 25 128 X	10 15 25 7 57 X	- 5 30 12 47	- - 6 12 18 X
Power Tillers Produced IRRI Models Other				1 Prototype	1 Prototype			
Other Agricultural Machinery	-					-	-	Water-Wheel Turbine
Other Products/Services	R&M					Beds	-	Engine Rim
Other Prototypes	Weeder					-	Weeder Trans-planter	Walk-Thru Thresher
Sales to Government to Dealers to Farmers Sales Area (radius) Price of Thresher Price of PT Tiller	- - 100% - $300 (w/o engine)	- - 100% - $600	- - 100% 70km $200 (for loop-power thresher) $65 (for pedal)	- - - - $725	10% - 90% 80km $700	- - 100% - $500	- 50% 50% 500km $650	- - 100% 40km $700
Weight Capacity			- 800 kg/hr	125kg 1000kg/hr		70kg -	70kg -	125kg 400kg/hr
Innovations Quality	Low Low	Med Med	Low High	High High	High High	High High	High High	High High
Person-days To Manufacture Thresher Low Costs Raw Materials Engine	9 $75 - -		6 - - $100		10 $25 $250 $200	- - - $125	15 - - $300	12 - - -

Table 3. Description of Small-Scale Machinery Fabricators: Family and "Superstar" Firms (cont.)

Item	Family Firms				Superstar Firms			
Firm Identification	K	L	M	N	O	P	Q	R
Location WS - West Sumatra NS - North Sumatra J - Java, Jakarta A - Aceh	WS	WS	NS	A	WS	WS	WS	NS
Total Employees	2	5	6	6	5-10	6	3	8
Working on Mag Machines								
Wages (per day)								
Minimum	-	$2.50	$2.00	-	$1.50	$2.50	-	$1.50
Maximum	-	-	$3.50	-	$2.50	$3.00	-	$3.00
Meals Included	Yes	Yes	Yes	-	Yes	Yes	-	Yes
Year Firm Started	pre-1975	pre-1960	1955	1965	1973	1974	1981	1966
Initial Product/Service	Repair & Maintenance	Blacksmith Implements	Blacksmith Implements	Bikes, Doors, Fences	Welding	Beds	Threshers	R&M
Initial No. of Employees	-				2	-	-	-
Rural/Urban Location	Rural	Rural	Urban	Urban	Rural	Rural	Urban	Urban
Plant Size (sq. m)	18	40	400	360	160	170	70	200
Layout Assessment	Med	Low	Med	Low	High	Med	High	Med
Uses Jigs/Fixtures	No	No	No	Yes	Yes	-	Yes	No
Own Generator		X	X	X	2	X	X	X
Lathes		X	X		X			X
Produces								
to Order	X	X	X	X	X	X	X	X
to Stock			X	X				
Owner Characteristics								
Age	60	60	65	60	35	40	38	26
Education	12yr	5yr	4yr	4yr	12yr	7yr	-	12yr
Farmer/Contractor	Farmer	-	Cntr.	Cntr.	Farmer/ Cntr.	Farmer	-	-
Association Member	-	-	-	-	-	-	-	-
Engineers on Staff	-	-	-	Yes	-	-	-	Yes
Training								
At Province	X	X			X	X	X	X
At Jakarta Workshop		X			X		X	
Other								Yanmar Serv.
Technical Assistance								
Intensive		X			X	X	X	
Extensive	X			X				X
Design Source								
Copy	X			X	X			
Blueprint						X	X	
Prototype		X	X		X		X	X
Credit								
To Firm	No	Yes	No	No	$13,000	$1,500	-	$2,800
To Customer	50%	Yes	Yes	Yes	75%	20%	Yes	No
Perceived Constraints								
Credit			X				X	
Demand	X			X	X			X
Other	Gov't Orders							

1. Firms for which the production of small-scale agricultural machinery is a sideline

2. Firms which are heavily oriented to Government contracts

3. Family businesses

4. "Superstars," or high performers

Coincidentally, the fabricators visited were divided almost evenly among the four groups, but there is some overlap (e.g., the "superstars" are small businesses and differentiated from our "family" category only as a result of their entrepreneurial bent).

In addition, the team visited several large-scale manufacturers of IRRI-type machinery who could not be characterized in this fashion. We are reasonably sure that any large- or medium-size fabricators in the provinces visited were not overlooked, but we did not attempt to identify, let alone visit, every blacksmith or small repair shop that may have made a few threshers to order.

2.2 Composite Models of the Fabricators

The following discussion of the fabricators is presented in terms of the four composite models, followed by a separate discussion of the larger firms. Where it makes sense, we generalize; where too much is lost by generalization, we offer specific examples of individual fabricators. Finally, we explore the implications of the variation among manufacturers' efforts to promote the manufacture and use of small-scale agricultural machinery.

2.2.1 Sideline Fabricators

The sideline fabricators include five of the earliest IRRI-DITPROD cooperators (see Table 2). The factor which distinguishes this group is its limited commitment to producing IRRI-type equipment. For them, small-farm machinery manufacture is a sideline in otherwise busy workshops. One of the firms is in car sales and repair, another is a general vehicle and heavy machinery repair workshop, a third is primarily a steel construction company.

When the program was first getting underway, it was necessary to identify a few manufacturers who would build adequate

prototypes for IRRI-DITPROD's own use and who could be counted on to initiate production in their respective areas. Success in promoting the use as well as the manufacture of the IRRI-type machinery was contingent on the introduction of reasonably high-quality equipment in sufficient numbers to demonstrate its usefulness. Accordingly, IRRI-DITPROD exerted great efforts to induce existing, well-equipped fabricators to produce IRRI prototypes. This group included the first Jakarta-based manufacturer (principally of the power tiller), as well as the initial producers of the TH-6 thresher in Padang and Bukittinggi (West Sumatra) and Bandung (West Java).

With one exception, the owners of these establishments are older, and all have a technical high school education. All five workshops are located in urban areas. They are now among the largest employers in the four groups, ranging in size from 16 to 125 employees. However, because small-scale agricultural machinery manufacture is a sideline, fewer than half of their employees should be attributed to this endeavor. One of the shops started up in 1952 with 2 employees and now has over 100, but only 30 are working on farm machinery production. The general repair shop started in 1956 with 5 employees and now has 25.[10]

The plants of the sideline fabricators are large, reasonably well laid-out, and well equipped with power tools and more sophisticated heavy machining tools. None, however, has the capability to heat-treat its products.[11] Early on, this group received intensive technical assistance from IRRI-DITPROD, including the provision of drawings and prototypes, as well as technical advice and training. Most if not all, also have received considerable assistance from IRRI-DITPROD in demonstrating and marketing their products. Sales have been to individual farmers and dealers and to Government, including IRRI-DITPROD. Their products are generally of medium-to-high quality, but exhibit little innovativeness.

Despite this unusually intensive technical assistance, two of the five fabricators in this group have ceased manufacturing IRRI-type machinery, returning full-time to earlier product

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[10]The team had problems determining employment in the firms, because family labor, seasonal changes, and multiple enterprises confound the data, not to mention the underreporting biases in any such survey where owners do not wish to give officials too accurate a picture of their business.

[11]Thus, one sideline firm had a very expensive crankshaft grinding machine, but in contrast, it had no facility to harden gears, which were being produced on standard lathes.

lines. All indicated that they have marketing problems, including insufficient effective demand, too much competition, and inadequate Government contracting opportunities. There are several possible explanations for their marketing difficulties. They may simply perceive that the profit margin and projected volume of business are less than with their main lines of business. This may be compounded by the fact that they are uniformly urban manufacturers, with weak linkages to the farmers who are their clientele. In addition, despite the fact that all are relatively large undertakings, they are not interested in providing credit to farmers in order to increase demand. Finally, they do not appear to have well-developed ties to Government purchasers.

2.2.2 Government-Oriented Fabricators

Five of the firms visited are categorized as Government-oriented (see Table 2). Three of these are relatively large, employing up to 156 employees; have quite well-equipped factories; and are oriented toward relatively large Government contracts. The other two operate out of Government facilities.

The owner of the Government-oriented firm is more of a businessman than an engineer. Because of his wide-ranging contacts, he keeps himself informed about Government programs. Knowing in advance about proposed large Government purchases of agricultural equipment, he positions his firm to obtain contracts. For example, the GOI sometimes directs banks to give "mass" credit for selected activities (see Appendix D). Such credit, which may be motivated by political concerns, is provided to an area for a specific purpose, such as the purchase of threshers. The manufacturer gets advance information and steps up production to meet the demand that will be generated by the mass credit program. Such firms also seek the inside track on sales to cooperatives and other Government agencies for "award" to model farmers.

The largest such firm is in Jakarta and produces relatively expensive equipment which the GOI purchases and distributes nationwide, including threshers, power tillers, and axial flow pumps. The factory also produces very large diameter axial flow pumps, sold mainly to a GOI agency for flood control and drainage. The business was started in 1979 as a separate enterprise by a large importing company and has grown to 156 employees.

Two other large Government-oriented firms in North Sumatra were gearing up to produce large numbers of threshers, because they had heard of proposed Government mass credit to finance the purchase of threshers in their province. One firm began producing back-pack chemical sprayers for the Government in 1979 and subsequently produced a prototype of the IRRI-type thresher,

reportedly working only from a photograph. It now has 15 employees, with approximately 4 working on threshers. The other firm began producing pedal threshers in 1976 with a few employees. It now has 18.

These three larger firms use some techniques of efficient batch production, including jigs and fixtures. However, product quality varied greatly, and no visible efforts were being made in quality control or final inspection.

The remaining two Government-oriented firms have somewhat different linkages to Government. One firm had started in July 1983 by renting the provincial agriculture office's workshop facilities, which had been sitting idle. The owner of the firm is a relative of the provincial agriculture director, who plays an important role in marketing the threshers. The other firm is an agricultural cooperative that makes threshers for sale to its members, to the GOI for distribution to other cooperatives, and occasionally for sale to private farmers.

Although all the firms in this group are oriented toward the Government market, the larger businesses are not dependent on Government training and technical assistance. They have at least some technical and management capability and have less need for industrial extension services. Nonetheless, they occasionally take advantage of such training and assistance. When producing a new product to meet expected Government demand, the firms either copy models produced by someone else (domestic or imported) or they secure blueprints for new models. Because the firms are usually more interested in profits than in producing an improved product, and because they frequently are far removed from the ultimate user, relatively little effort is expended on modifying designs.

The owners of this type of firm believe that demand is the major constraint to sales expansion. They seem reluctant to actively promote sales to individual farmers, preferring to sell in larger quantities to dealers or the Government. They therefore see expanded Government credit programs or direct purchases as the best way to develop the market.

2.2.3 Family Firms

One of the firms visited by the team was called "Family," a term which we found to be an apt description of the smaller workshops visited. Although almost all firms visited in fact were operated as family-owned enterprises, one group was differentiated by virtue of its size, management, and source of labor. The family firms are typically run by an elderly couple with

limited education and employ two to six family members, as well as a few others at relatively low wages.

These enterprises are numerous and no doubt underrepresented in the sample of manufacturers interviewed by the team. Table 3 describes our observations for four such firms visited. The four firms started as rural machinery repair or blacksmith operations more than two decades ago and evolved into fabricators of relatively simple farm implements and machinery, such as plows or threshers. The shops are equipped with relatively simple tools, although two have lathes. Simple fabrication techniques are used, and the quality of the finished product depends in large measure on the skill and dedication of the owner. Financial backing for two firms came from the family, while two secured limited institutional credit for investments in new equipment and for working capital.

These family firms provide repair services, and they fabricate a variety of products which may include nonagricultural products. Over a 3-year period, one firm produced 250 wire-loop threshers from a Taiwanese design. Fifty were large and machine powered; the balance were pedal powered. Interestingly, the owner reported that he had never heard of IRRI, although a competitor was producing IRRI-type threshers just a few miles down the trunk road. Most threshers, as well as other fabrication jobs, are made to order and sold directly to farmers and other consumers. Smaller pieces, such as hoes and plow blades, are produced for inventory and sold through dealers. For threshers, the prices charged and quality are roughly similar to those of other types of fabricators.

The family firms visited do not appear to have the technical capability or background to work from blueprints. They introduce new products by copying. Although their years of metalworking experience make them relatively adept at copying, their first copies are somewhat experimental. Succeeding copies tend to be better.

If given the opportunity, many, but not all, take advantage of Government-sponsored training and technical assistance. Most are in relatively close contact with the users of their products; therefore, they have a ready source of feedback for improving their products. However, only one firm was rated as high in innovation (see Table 3), one as medium, and two as low, which suggests these firms are fairly resistant to change.

One of the family firms in West Sumatra is located in a village where blacksmiths were selected for special attention by the Ministry of Industry. This firm receives considerable extension services (see Appendix E). The other family firms received little or no technical assistance. One owner in the West Sumatra

pilot area sent his son for training at the Bukittinggi workshop, but declined training for himself.

Family firms reported that demand and marketing are their main constraints. In addition, they lack the equipment and production management know-how necessary for expanding production to any significant degree. Most demonstrate their products to farmers, and some allow farmers to pay in two or three installments (after harvest). However, in their opinion, farmers often cannot afford costly products such as the US$600 thresher. Some would like to get Government contracts, but most do not consider the GOI a potential buyer; instead, they want farmers to receive subsidized credit for the purchase of farm equipment.

2.2.4 "Superstar" Firms

In our discussions with the project staff, the term "superstar" was applied to one of the most enterprising and risk-taking IRRI-DITPROD cooperators. Our subsequent analysis concluded that there were four superstars, or outstanding performers, showing great promise.

Although these firms' output is still relatively small (ranging from 18 to 113 threshers total production last year), their sales growth is impressive, as indicated in Table 3. One welder started a shop with 2 employees in 1973. He produced three threshers in 1981, 30 in 1982, and 73 in 1983, with 10 in process in January 1984. He now employees 5 to 10 workers (depending on the season). A second firm began making metal beds in 1974, threshers in 1981, and now has 6 full-time employees. Its annual thresher production was 10 in 1981, 15 in 1982, and 25 in 1982, with 7 in process in 1984.

We found two superstar firms in larger provincial towns and two in villages. The owners are all young, ranging in age from 26 to 40. All have some junior or senior high school technical training. The firms are smaller than the sideline and Government-oriented firms, employing between 3 and 10 people. They are equipped basically with machines needed for thresher manufacture: drill presses, generators, welding equipment, and, in two cases, lathes. Most also employ simple jigs and fixtures in the fabrication process.

The products from this group are of high quality, and these fabricators are the most innovative. All have modified their threshers, based on farmer feedback, and improve the design each year. The modifications have generally reduced the weight of the threshers, eliminated clogging, and increased capacity (see Section 3 and Appendix G). The IRRI-DITPROD project staff judge most of the innovations to be improvements.

The three West Sumatran fabricators in this group have received intensive assistance, including special training and frequent technical advice. They mostly use blueprints, and they copy prototypes. The technology transfer to two of the West Sumatran fabricators deserves special mention.

One firm near Padang has been selected not only as an IRRI-DITPROD cooperator but also as a pilot firm under an IBRD-funded small enterprise development project to encourage provincial bank branches to extend credit to small-scale industry. Therefore, the owner has received substantial assistance with plant layout and equipment selection, and he has had access to as much credit as he could use.

A second fabricator in this group has worked for 10 years at the Bukittinggi Government workshop. Recently he set up a very small workshop at his home and in short order produced nearly 50 threshers. He is fully knowledgeable about the IRRI designs and about manufacturing technologies and production management issues, as taught at IRRI-DITPROD seminars and in local training courses.

The North Sumatran firm included in the group has not received assistance from the IRRI-DITPROD project, but has been contacted by the farm machinery specialist on the provincial agricultural staff. The firm started as basically a repair and maintenance shop in 1966 and now fabricates water-wheel turbines, corn shellers, and a walk-through thresher of the owner's design, in addition to a copy of the IRRI TH-6 model. The business was categorized as a superstar because the owner-manager's innovativeness, quality of work, and demonstrated entrepreneurial skills distinguish it from the family or sideline firms.

The superstar firms produce to order, keeping no inventory of threshers. Sales are almost exclusively to farmers. Most offer limited credit in the form of installment payments and apparently charge no interest to their clients. These firms are committed to producing an increasing volume of threshers, and they identified fewer constraints to expanded production than other groups. When problems were mentioned, they included credit and marketing constraints. The marketing strategy of one superstar firm is of particular interest. At his small rural repair shop, the owner produced three IRRI-type threshers in 1981. In 1982 he made 30 units, some of which he loaned to farmers. To demonstrate the machines, he did contract threshing, receiving between 7 and 10 percent of the crop as payment. Having thus established a market for the thresher, he made and sold 70 in 1983. In the first month of 1984, he sold another 10 units, and 15 were in process at the time of this study.

As a spinoff of this fabricator's success, his largest customer now runs a highly profitable contract threshing business, using the IRRI-type machines. When this contractor sensed too much competition in the threshing business, he began to use a portion of his substantial earnings to offer credit to farmers for fertilizer and other inputs. He charges no interest, but the loans are conditional on the farmers' utilization of his threshing services exclusively. Because of the limited access of small farmers to institutional credit, this tactic has increased his business still further, and he has placed new orders with his friend, the IRRI-DITPROD cooperator.

2.2.5 Other Producers

We visited several manufacturing operations that do not fit readily into the four groupings of small-scale fabricators,[12] but they do help to place our field survey into perspective. One private firm operates in a Ministry of Industry mini-industrial estate in West Java; the other two, located in Central Java and Yogyakarta, operate on such a vastly different scale that they are more readily contrasted with each other than with the small-scale local manufacturers we visited in West Java and Sumatra. These latter two firms are discussed later in the context of economies of scale and location (Section 2.3.2).

The firm visited in Sukabumi, West Java fabricates over 100 large drum threshers annually. The design was copied and adapted from a Japanese thresher. The threshers are sold to dealers, cooperatives, and directly to farmers who use the machines for custom-hire operations. The firm recently opened a second workshop in the Ministry of Industry Lingkungan Industri Kecil (LIK) mini-industrial estate (see Appendix E) and expanded employment from 12 to 28. Considerable technical assistance was obtained from the Ministry of Industry but not IRRI-DITPROD.

2.3 Cross-Cutting Issues

2.3.1 Marketing, Credit, and Demand

Nearly all the manufacturers interviewed sell at least some of their products directly to farmers; several work through dealers or distributors; and a number sell directly to the Government. The most common sales promotion technique is field

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[12]We have excluded them from Tables 2 and 3 for this reason.

demonstration of machinery by the manufacturer; several firms also engage in contract threshing. Marketing is assisted directly by demonstrations and field days sponsored by IRRI-DITPROD and provincial agricultural extension workers, who sometimes recommend specific firms to farmers as sources of machinery.

Despite the successes of many of the manufacturers, most have no definite plans for expanding their production, because of perceived limited demand for their products. They speculate that this is a direct result of the inaccessibility of institutional credit to the small rice farmer. Farmers are often unaware that they are eligible for bank loans, and even when they are aware of credit availability, they prefer not to pay all the costs associated with securing a loan.

Fortunately for the farmers, some manufacturers offer credit to their buyers in the form of installment payments (although not nearly at the level that occurs in Thailand). Generally, the buyer pays 40 to 60 percent of the cost when he places his order and the balance on delivery. A few manufacturers accept installment payments after the next harvest. None reports charging interest, apparently absorbing the cost as a necessary marketing cost.

Despite the fact that reported delinquencies are rare, many manufacturers do not extend credit at all, expecting payment in full on delivery. This is probably attributable to bad experiences with extending credit for Japanese mini-tractors, which were imported in West Sumatra and elsewhere in significant numbers several years ago. Because it was not possible to obtain the spare parts needed to keep the mini-tractors running, farmers were unable to repay their loans. This history of substantial defaults is well known to both manufacturers and rural banks.

2.3.2 Economies of Scale and Location--the Large Manufacturers

Although this study focuses on the small-scale enterprises that were recipients of the technology transfer efforts of the IRRI-DITPROD project, the evaluation team made a special effort to visit two factories with a vastly different scale of operations, one in Semarang, Central Java Province, and the other in Yogyakarta. The largest agricultural machinery manufacturer in Indonesia is Karya Hidup Sentosa (Quick) located in Yogyakarta, about 230 kilometers east of Jakarta. The factory was established in 1953 with three workers. It now has 650, after peaking at over 800 in 1981. Quick distributes farm machinery throughout Indonesia and has a branch office in Jakarta. Since 1979, the company has reportedly sold 1,000 threshers of IRRI design and 2,900 power tillers. Forty percent of the total sales were reportedly on credit.

The company has been an official IRRI cooperator since 1979. IRRI blueprints were made available for the IRRI PT power tiller, but the line was dropped after 10 units were produced, because it was deemed not sturdy enough for local conditions. Instead, the factory now produces a much heavier power tiller derived from a Thai model.

The other company, Kubota Indonesia, is a joint venture of Kubota Corporation, a Japanese transnational company, and Garuda Diesel Company. It was established in 1973 with 60-percent foreign capital. Diesel engines, which range in size from 3 to 22 horsepower, are produced on a typical modern factory assembly line. The factory, located near Semarang in Central Java, employs 250 workers and has a design/administrative staff of approximately 20 people.

The Kubota Indonesia factory is of special interest because GOI regulations require the joint venture to reach 90 percent local content in its products by 1985. Therefore, it has nurtured a number of small-scale industries that supply engine components. Kubota Indonesia's support of these small-scale enterprises was reportedly one important model for the Ministry of Industry Foster Parent Program (see Section 4 and Appendix E).

After the factory decided in 1979 that its parent company's brand of imported Kubota power tillers was too costly for the local market, it developed a simpler model from IRRI and Thai designs. Although production began in 1981, to date only 230 units have been produced, of which approximately 100 remain unsold. Annual production of 600 units is necessary to break even. Sales have been to farmers (50 percent) and dealers (30 percent), with the balance to the Government.

In general, the Kubota Indonesia operation is well managed and impressive, and its experimentation with power tiller fabrication provides an interesting comparison to the uptake and adaptation of the technology by the very small enterprises we observed elsewhere. However, Kubota Indonesia's power tiller manufacture has clearly not taken off as planned. The original concept was to produce only the transmission, leaving the supporting structure for local industries to fabricate. Kubota Indonesia was willing to let these local industries market the assembled power tiller under their own brand names, provided that the Kubota engine powered it. The managing director reported, however, that local industries were not willing to undertake production, apparently not convinced that the demand is there.

Contrasting the indigenous Karya Hidup Sentosa Company in Yogyakarta with the Kubota Indonesia joint venture in Semarang reveals some unexpected, albeit subjective, observations. The indigenous firm is actually running on a much larger scale of

operations, if not a substantially larger volume of business. However, differences in plant layout and working environment, equipment, and pay levels clearly favor Kubota. In brief visits it is hard to make more than a superficial assessment of the efficiency of plant operations, but it appears that the wholly domestic operation in Yogyakarta would benefit from an increased transfer of manufacturing and technological know-how and production management.

Furthermore, Karya Hidup Sentosa operates as a closed, vertically oriented production company, from scrap material purchase through sales and distribution. Through economies of scale it has the potential to dominate nearby small industries, whether foundry, machine shop, or metal fabrication, including manufacturers of small-scale agricultural equipment. In comparison, the Kubota Indonesia joint venture strengthens local industries through its subcontracting practices, and the company seems to be playing a genuine industrial foster parent role.

Arguments based on economies of scale and industrial location theory would favor a few large firms supplying standard farm machinery products at a few select regional centers where there is demand for mechanized farm machinery. However, there are drawbacks to relying on a few larger manufacturers to produce small-scale agricultural machinery. These considerations are pertinent to IRRI-DITPROD and the Subdirectorate, because they allocate scarce technical assistance and training resources to firms with the best prospects for sustained quality production.

The very largest firms (Kubota Indonesia in Semarang and Karya Hidup Sentosa in Yogyakarta) are not responsive to local conditions, which argue for continual adaptation of the machinery. Furthermore, they are not geared to providing after-sales service to scattered rural farmers. Even if they were to establish a dealer-service network, it would be unlikely to extend to the district level where the small-scale manufacturers are located. These disadvantages may be offset somewhat in the case of the power tiller, which is technologically less suited to very small-scale manufacture.

2.3.3 Prospects for Sustained Manufacture of Small-Scale Farm Machinery

The superstar entrepreneurs and family firms appear the most likely to sustain production of small-scale agricultural machinery, coupled with servicing. Because of their growing output, the superstar firms are fast becoming a committed nucleus of small producers. As a result of their innovativeness and energy, they are finding and responding to an expanding market for their

products. Furthermore, it is probable that the superstars will produce increasingly for inventory, as their capital expands and their access to credit improves. Finally, this group exhibits sufficient technical skills that it may be able to successfully add the IRRI-type power tiller to its production line.

The family businesses, having made the initial investment in the technology, also appear likely to remain producers of farm implements and the thresher, although they are less likely to be able to produce the more sophisticated power tiller. Furthermore, they are probably too marginal to expand thresher production significantly, because they always produce to order.

It could be argued that the superstar and family firms are simply different subsets of the smallest manufacturers. The older, less risk-taking family firms respond to the introduction of the new technology in a limited way, remaining repair shops and blacksmiths at heart. In comparison, the younger, more enterprising superstars respond to a growing market for small-scale agricultural machines and stimulate market growth by actively promoting the use of the thresher themselves. Through their efforts, the technology "sells itself."

The sideline-type manufacturers are less likely to sustain manufacture and servicing of small-scale agricultural machinery, although their products are generally of good quality. Nevertheless, they do serve the very valuable purpose of assisting IRRI-DITPROD to introduce new technologies by fabricating and, with considerable assistance, marketing the first models.

The commitment of Government-oriented firms to the manufacture of small-scale agricultural machinery is limited, because they respond to Government procurement efforts rather than market forces. Furthermore, because of their reliance on Government contracts, they lobby for additional public purchase and distribution of machines. Inherent in this situation is the danger that the Government will oversubsidize manufacture and then have to "dump" large quantities of machines. In addition to jeopardizing the development of a dispersed, small-scale industry, this situation could fuel the mechanization debate, which is sustained by the concern over labor displacement.

IRRI-DITPROD's concentration on "intensive" assistance (see Section 3.2.2) first to the so-called sideline firms and then to the smaller, committed entrepreneurs and family businesses makes sense in view of the characteristics of different groups of fabricators. The difficulty of anticipating which of the smallest firms will become superstars and which will remain more marginal producers argues for continuing the wait-and-see approach of V.R. Reddy and the Subdirectorate, which target "reactive" assistance (see Section 3.2.3) to those firms that exhibit adequate manufacturing capability and a desire to grow

and expand production. In Section 3 we will examine this industrial extension strategy in some detail, and in Section 4 we consider alternative means for fostering the technological development of a small-scale farm machinery industry.

3. THE TRANSFER OF TECHNOLOGY TO THE AGRICULTURAL MACHINERY INDUSTRY

Although the primary focus of the evaluation team was on the status and future prospects of small-scale farm machinery fabricators, we also examined the efforts by the GOI, with AID assistance, to promote the manufacture and use of IRRI-type machinery. Our aim was to analyze the relationship between the changes observed in the private enterprises and the strategy and subsequent interventions by IRRI-DITPROD that were intended to promote their technological development.

In this section we briefly describe the institutional locus of the project, that is, IRRI-DITPROD, and then characterize the IRRI-DITPROD approach. The description of industrial extension includes independent approaches by private, voluntary, and international institutions promoting the technological development of an indigenous farm machinery manufacturing capability.

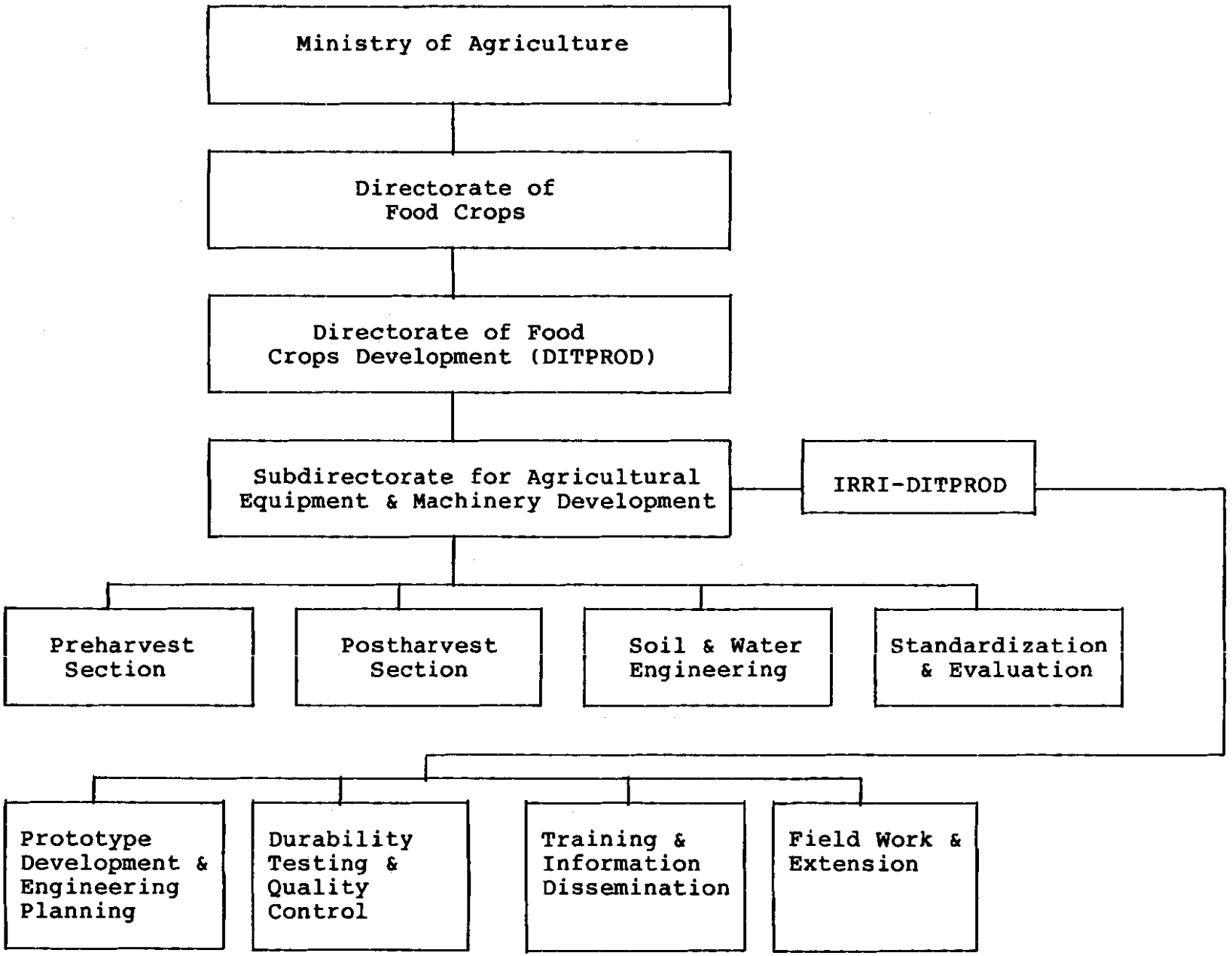
The innovativeness of the fabricators is assumed to be a healthy sign of growth and, to a considerable extent, indicates the nature and quality of technical assistance provided to them. Hence, we summarize our observations on the innovations observed in the field study (detailed in Appendix G). This admittedly subjective assessment, together with our prognosis of the prospects for further growth of the industry (see Section 2.3.3), forms a basis for evaluating the overall strategy.

3.1 The Institutional Framework for the Project Intervention

The key GOI institution with a mandate to promote agricultural mechanization is the Subdirectorate on Agricultural Mechanization within the Directorate for Food Production (DITPROD) in the Ministry of Agriculture (see Figure 1). While the Subdirectorate has basically an extension responsibility for agricultural mechanization, it also has become involved in planning mechanization projects and in research and development. These activities have been supported by the AID-financed project to promote the manufacture of IRRI-type machinery (see the project description in Appendix B).

The IRRI-DITPROD staff of 43 includes 3 engineers and 27 semiskilled and unskilled workers attached to the project. The

Figure 1. IRRI-DITPROD Organization Chart



staff is spread among four functional sections: prototype development and engineering planning, durability testing and quality control, training and information dissemination, and field work and extension. The prototype development and engineering planning unit builds prototypes and production aids such as jigs and fixtures, translates drawings into Bahasa Indonesian, standardizes materials and components, and studies materials planning and cost reduction. The testing and quality control unit does performance and field testing of locally built IRRI-type equipment and suggests modifications. The training and information unit prepares and translates training materials, conducts training programs (in Jakarta at least twice a year and in each target province once a year), and publishes program materials. The field extension unit works with provincial agriculture extension departments to select areas for demonstrations, to identify cooperating workshops, and to coordinate with Ministry of Industry personnel and credit agencies.

3.2 The IRRI-DITPROD Approach to the Promotion of Technological Development

The plan for AID's Industrial Extension of Small-Scale Agricultural Machinery project was to begin by introducing the technology and building up the capability to produce it locally, while stimulating demand through demonstration. Once this phase was complete, it was assumed that other entrepreneurs would emerge to sustain and improve the program.

3.2.1 Startup Phase

The technology transfer strategy of IRRI-DITPROD developed, through trial and error, roughly according to the sequence of steps illustrated in Figure 2. The IRRI technology entered Indonesia in the form of prototypes, blueprints, specifications, and instructions prepared by IRRI-Los Banos. An immediate concern was to obtain an initial stock of appropriately adapted IRRI-type machines to deploy to the field for testing and eventual commercial manufacture.

The selection of IRRI-DITPROD project areas for the introduction of the IRRI machines (first West Sumatra and West and Central Java, followed by South Kalimantan and South Sulawesi) was largely a function of opportunity and expediency. Areas were selected that had high wage rates (suggesting a labor shortage), a potential for multiple cropping, and appropriate physical and socioeconomic conditions for the introduction of IRRI-type equipment. For example, one of the important reasons West Sumatra was selected as the initial pilot area is that the Minangcabao people

Figure 2. Startup Sequence for IRRI-DITPROD Project

1. **INDENTIFY AGRICULTURAL MECHANIZATION NEEDS AND OPPORTUNITIES**

   a. Select pilot areas.
   b. Match existing IRRI machinery stock to areas.
   c. Test feasibility, using Los Banos-supplied equipment.

2. **MANUFACTURE INITIAL STOCK OF PROTOTYPES**

   a. Translate blueprints and adjust for locally available materials and local manufacturing practices.
   b. Identify initial cooperating manufacturers and supply them with designs and prototypes from IRRI-DITPROD.
   c. Persuade firms to manufacture initial order.
   d. Build prototypes at Jakarta workshop using locally available materials.

3. **TEST INITIAL PROTOTYPES**

   a. Test at central workshop.
   b. Select sites for field testing.

4. **ADAPT ORIGINAL IRRI DESIGNS TO LOCAL CONDITIONS**

   a. Modify for performance requirements.
   b. Modify and design jigs to aid and standardize manufacture.
   c. Modify for local manufacturing capability.

5. **DISTRIBUTE LOCALLY ADAPTED DESIGNS TO ENTERPRISES AND COOPERATING INSTITUTIONS IN PILOT AREAS**

   a. To research stations.
   b. To agricultural extension services and cooperatives.
   c. To potential manufacturers, including both Government and private workshops.
   d. To others (e.g., externally financed agricultural projects).

6. **DEVELOP TRAINING AND EXTENSION PROGRAM**

are very enterprising and have a long history of mining, smelting, brass-cutting, and forging weapons.

Identifying and then persuading the first selected workshops to manufacture an initial stock of IRRI machines (Figure 2, Step 2) posed problems. Important motivating factors were intense marketing assistance from IRRI-DITPROD and the prospect of further Government orders. The testing of these initial machines proved crucial, because field tests in several instances showed the quality to be inadequate. This caused a setback in the West Sumatra pilot area, when power tillers supplied for demonstration to early cooperators broke down prematurely. This discouraged adoption, and hence commercial production.

3.2.2 The Intensive Approach

The typical sequence of activities undertaken after startup by the IRRI-DITPROD team (principally V.R. Reddy) is listed in the upper left quadrant of Figure 3. Although it follows the startup process represented in Figure 2, there are some important distinctions. The link to IRRI-Los Banos continues the training of Indonesians and the transmittal and feedback of improvements and modifications, but the ties between the project areas and IRRI-DITPROD in Jakarta become more critical. The intensive approach involves considerable technical assistance, persuasion, and institutional cooperation. Although represented as a sequence of discrete steps in Figure 3, the order will vary from one area to another, because a flexible approach is needed to respond to unforeseen problems and opportunities, especially in assisting market development.

The intensive approach implies a two-way flow of information, with essential feedback provided by farmers and contract operators to the manufacturer and IRRI-DITPROD, as well as feedback to IRRI-Los Banos (Figure 3, Step 7). The IRRI-DITPROD approach also encourages sharing of design innovations by one manufacturer with other cooperators, both through informal contacts and through incorporation of successfully tested improvements into the standard design. (The problem of openly sharing proprietary information with competitors raises some interesting issues, but was reportedly not a significant problem.)

A number of other institutions cooperate with IRRI-DITPROD:

-- Provincial agricultural offices provide essential field assistance, especially in identifying potential cooperators and stimulating market demand through demonstrations (Figure 3, Steps 2, 7, and 10). (The role and capabilities of the extension network are discussed under the "Extensive Approach, Section 3.2.4.)

Figure 3. Steps in the Transfer of Technology to Manufacturers of Small-Scale Agricultural Machinery

	Promoted Technology Transfer	Spontaneous Development of Technology
Targeted Project Areas	**Intensive Approach** 1. Stimulate demand through demonstrations and direct assistance in arranging sales. 2. Identify potential cooperating manufacturers. 3. Persuade to produce prototypes. 4. Supply model and/or drawings, and jigs/fixtures, if available. 5. Provide training in manufacture. 6. Test performance and quality of initial production. 7. Stimulate demand through demonstrations and marketing assistance to arrange early sales. 8. Assess manufacturer innovations. 9. Incorporate improvements into workshop designs and prototypes. 10. Advise on other modifications (from IRRI, central workshops, and other cooperators). 11. Assist in obtaining credit and developing market. 12. Persuade workshop to expand production and add new lines.	**Reactive Approach** 1. Manufacturer copies IRRI-type design on own initiative. 2. Manufacturer produces IRRI-type equipment to order. 3. Provincial staff discovers manufacturer. 4. Manufacturer is approached by IRRI-DITPROD. 5. If invited to cooperate, then steps 4-12 under "intensive approach" are followed. 6. If operation is judged marginal, then minimal assistance is provided, followed by a wait-and-see approach before proceeding with steps 4-12 under "intensive approach."
Nonproject Areas	**Extensive Approach** 1. Provinces ranked according to priority by subdirectorate. 2. Provincial mechanization officers receive central training. 3. Government provincial workshops supplied with prototypes for demonstration and training. 4. Local manufacturers identified. 5. Technology transferred to them (copies, designs). 6. Progress monitored. 7. Product quality tested. 8. Innovations/modifications tested. 9. Assistance provided in arranging credit/sales. 10. Manufacturer exposed to wider range of products and encouraged to expand product line.	**Independent** 1. Private sector initiatives: - Joint ventures established with transnational corporations - Manufacturers copy imports (e.g., Chinese reaper, Thai power tiller) - Traditional designs improved (e.g., wire-loop pedal thresher) 2. Possible support from other Government programs or nongovernmental organizations: - Ministry of Industry mini-industrial estate programs - Ministry of Industry Foster Parent program - Regional Project Management Units - Yayasan Dian Desa appropriate technology 3. Possible testing and certification by Subdirectorate.

-- The Ministry of Industry has several programs that support IRRI-DITPROD intensive efforts, but except for some training and credit programs, the coordination is weak. The Metal Industry Development Centre (MIDC) at Bandung assists the local metal industry in the technical and management aspects of manufacture. It has been supported generously by Belgium and by UNIDO and West Germany. Recently, MIDC sent two representatives to a 2-week power tiller training course organized by IRRI-DITPROD at Bukittinggi to provide assistance in improving metalworking skills. The Ministry's small-scale industry promotion program, BIPIK, provides technical assistance and equipment to a limited number of manufacturers, including one IRRI-DITPROD cooperator in a blacksmith village near Bukittinggi.

-- Other organizations that are supportive to varying degrees include cooperatives, banks, and IRRI-Los Banos; they are discussed later in this section.

3.2.3 The Reactive Approach

The intensive approach described above may lead other workshops to "react" and copy the designs, sometimes from models produced and exported by cooperators. The reactive approach (upper right quadrant of Figure 3) may follow the same sequence as the intensive approach once the manufacturer and IRRI-DITPROD discover one another. However, some of these "spontaneous" enterprises are decidedly marginal, in which case IRRI-DITPROD proceeds cautiously. Others may simply see no need to cooperate with IRRI-DITPROD. Nonetheless, all such manufacturers are of potential interest to the IRRI-DITPROD team as it monitors the technology diffusion process.

V.R. Reddy firmly believes that the marketplace should ultimately decide which fabricators have the better product and hence the better chance for long-term growth. He therefore welcomes competition among fabricators, although there would be little gain, and perhaps some significant negative demonstration effects, if initial market penetration were left to inferior products. Yet, IRRI-DITPROD budget limitations argue for some degree of discrimination among manufacturers. The compromise is an apparent wait-and-see tactic (Figure 3, Step 6), which involves giving some limited initial advice, followed by technical assistance and training, if warranted.

3.2.4 The Extensive Approach

IRRI-DITPROD, while limiting its intensive activities to four project areas, also has supported the extensive approach adopted by the Subdirectorate for Agricultural Mechanization (lower left quadrant of Figure 3). This approach, characterized by the GOI as "selective mechanization for targeted provinces" (see Appendix F), relies on provincial mechanization officers to promote local farm machinery manufacture and its use. The provincial staff typically has only a small budget for machinery and fieldwork, an inadequate workshop geared toward maintaining provincial vehicles and imported farm machinery, and little, if any, experience in industrial extension.

IRRI-DITPROD has provided training in Jakarta for selected mechanization specialists from provincial agricultural extension offices. Other officers posted for a time with the Subdirectorate or IRRI-DITPROD have rotated to the field. Thus, the knowledge transfer process has started. Many provincial agricultural offices have direct experience with the problem of maintaining a variety of imported farm machinery when the initial stock of spare parts runs out. For instance, at a Government workshop in a northern Sumatran province, half a dozen large four-wheel tractors have sat idle for many years, inoperable in part because of the difficulty and cost of acquiring spare parts.

However, it is questionable whether the provincial mechanization staffs can take a leading role in stimulating the growth of small-scale agricultural machinery manufacture because of limited budgets and their untested technical assistance skills. The annual GOI budget for DITPROD is roughly US$500,000 excluding salaries. The Subdirectorate's 1984-1985 budget is US$85,000, also excluding salaries. The budgets for provincial agricultural mechanization activities in DITPROD's 27 target provinces total US$848,000 for 1984-1985. Although these amounts are spread thinly, the 1984-1985 budget represents a twofold increase over last year's, which suggests that the Government is according mechanization a higher priority. However, the turnover among the engineers has been rather high, and the team has doubts about the skills of the field staff charged with mechanization extension responsibility in the provincial offices. Other potential problems facing the extensive approach to industrial extension include the indifference of the rest of the provincial agricultural staff, failure to talk to the farmer first and find out what he wants (i.e., what he will pay to use), very limited coordination with Ministry of Industry extension staff, and lack of influence with potential sources of credit for manufacturers and buyers.

Therefore, in any target area, success of the extensive approach depends on a combination of factors--the active support of the Ministry of Agriculture provincial chief, the individual

interests and skills of provincial mechanization officers, and the stimulus of Government purchases of farm machinery. The Ministry of Agriculture provincial chief in Banda Aceh has taken several steps to introduce IRRI-type threshers. He has imported several units of the thresher from a West Sumatra manufacturer and has proposed a novel arrangement for extension officers to buy threshers for demonstration on credit, and repay in installments while earning outside income by providing contract services. Although such individual initiatives reflect an appreciation of the need to establish local manufacturing capability, they appear to be ad hoc and unlinked to overall GOI mechanization strategy.

The DITPROD Subdirectorate on Agricultural Mechanization receives other assistance in addition to that from IRRI. The United Nations-funded Regional Network for Agricultural Machinery (RNAM) assists Indonesia in achieving agricultural mechanization through the promotion of local manufacture and popularization of proven equipment. It has no workshop or field activities, but provides DITPROD with prototypes for its workshop from other countries in the network and sponsors seminars and training. The team concluded that this information-dissemination approach, despite its promise, has had only a marginal impact.[13] (See Section 4.6 for further detail.)

3.3 Development Independent of IRRI-DITPROD or the Subdirectorate

There are numerous examples of firms engaging in agriculture machinery manufacture independently of IRRI-DITPROD or the Subdirectorate, if not altogether independently of public sector agencies. We have listed some of these independent approaches in the lower right quadrant of Figure 3. Some examples are described below:

-- Technology adoption has occurred in several instances when private firms have imported and then copied machinery from other countries, for example, the Thai-type power tiller. Because of the simplicity of the machinery designs, the fabrication process is self-evident and is thus easily copied.

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[13]We had the opportunity to talk with the new director of RNAM at the Headquarters in Los Banos and found him enthusiastic about the possibilities of the networking approach, but not altogether convincing about the outreach of knowledge transfer within the member countries.

-- Joint ventures with Japanese firms (Kubota, Yanmar) have led to some small-scale production of both power tillers and threshers (see Section 2).

-- The Ministry of Industry stimulates development of local small firms through various programs. The previously cited Bapak Angkat or Foster Parent program encourages assemblers and major buyers of components such as Kubota to support small producers through subcontract mechanisms. MIDC assists metal manufacturers generally, including fabricators of agricultural machinery. Finally, the Ministry of Industry provides intensive technical assistance to firms located in industrial estates. Several IRRI-DITPROD cooperators also received Ministry of Industry assistance.

-- The World Bank and, more recently, the German aid program are supporting a small enterprise development project with Bank Indonesia to train bankers in assessing credit applicants' projects, with a view toward increasing credit availability to rural small-scale enterprises. To this end, they established a Regional Project Management Unit (RPMU) to identify entrepreneurs and undertake feasibility studies and pilot projects. In West Sumatra, RPMU is working with one of the most successful IRRI-DITPROD cooperators who has received credit and technical assistance to improve his facility and equipment. Another cooperator has been identified by RPMU and is being assisted similarly. They also plan to assist in the provision of credit to custom-hire machinery operators.

-- Improvements to traditional designs also have been made and disseminated, through independent channels. For example, the pedal-powered, wire-loop thresher was modified for commercial production by Yayasan Dian Desa, a private foundation in Yogyakarta. The IRRI-DITPROD workshop has followed up with experiments to increase efficiency and cut costs of production, and Dian Desa works to extend new ideas into commercial production. This nonprofit organization assists the technological development of metalworkers and other small-scale enterprises; its activities are concentrated in Central Java. The founder of Dian Desa is a Magsaysay Award winner, and the organization has been recognized as one of Asia's most successful efforts to stimulate the use of appropriate engineering technology, especially in the field of agriculture. Grant assistance comes from USAID directly and from Appropriate Technology International.

These other initiatives and support programs are not ignored by IRRI-DITPROD or the Subdirectorate. Both have tested and certified agricultural machinery products introduced through these alternative channels of technology transfer. However, adequately monitoring and screening these diverse sources would leave little staff time and budget for industrial extension activities. The Japanese are proposing to construct a US$8.5 million Center for the Development of Appropriate Engineering Technology for DITPROD, which would include a workshop and testing center. Although this would greatly expand the physical facilities and equipment for the testing and adaptation of farm machinery, the team does not see how this would strengthen outreach capability without the provision of considerable technical assistance, at least in the short term.

3.4 Innovativeness

The overall level of innovativeness of IRRI-DITPROD cooperators is high, and experimentation and modification of designs are evident. Generally, the fabricators have made changes in the following areas:

-- The structural design of the thresher, aimed mainly at cutting costs or strengthening durability and structural integrity

-- The design, aimed principally at improving the performance or simplifying use and maintenance

-- The fabrication process

-- The design or simply appearance, unrelated to either structure or performance, but affecting product marketability

In the following paragraphs we briefly comment on the changes observed and their significance. (Specific modifications observed by the team are listed in Appendix G.) The need to adapt the machines to local conditions varies with each machine and different environments. We have paid some attention to the kinds and quantity of innovations originating from the small fabricators themselves. We view this innovativeness as an indication of the vitality of the entrepreneurs, as well as the success of IRRI-DITPROD and Subdirectorate industrial extension efforts.

3.4.1 Structural Changes to the Thresher

One of the most interesting changes to the thresher design is the widespread effort to reduce its weight to make it more portable and less costly to produce. The IRRI TH-6 specifications list the weight without engine at 125 kilograms (kg). In West Sumatra, the thresher weight has been reduced from an initial 140 kg to 75 kg, nearly a 50-percent reduction. One manufacturer further improved the portability of his product by providing bicycle wheels at an additional cost. The IRRI-DITPROD agricultural consultant, V.R. Reddy, seems impressed by these improvements and lets other manufacturers know about the weight reduction improvements made by these firms.

Manufacturers in Aceh Province are not stressing weight reduction, because of the local practice of feeding tied rice bundles into the thresher, which subjects it to uneven loading and rapid breakdown. The resistance of the local population to changing traditional farming practices to avoid this problem points to the need for local adaptation of machinery, along with extension efforts to train farmers and machinery operators in ways to better use the machines. V.R. Reddy observed during our visit that these threshers "still need more adaptation and quality improvement."

3.4.2 Performance

Some modifications to the original IRRI designs are aimed at increasing the thresher's capacity, reducing the power requirement, and improving the cleaning action. Because the cleanliness of the grain is easily observed by thresher users and affects the price of rice, successful modifications in this area are likely to be quickly diffused to other manufacturers.

3.4.3 Fabrication and Manufacturing Process Changes

One aspect of industrial extension activity leads directly to improved product quality and production efficiency. This is the design and use of jigs and fixtures, which hold the components during machining and assembly. Very few jigs or fixtures of any sort are in evidence, and some are too crude to simplify manufacture or provide much in the way of standardization. This lack of innovation in the manufacturing process may be a sign of weakness in the IRRI-DITPROD outreach program. However, there are exceptions to this generalization. For instance, much IRRI-DITPROD effort went into making a fixture for manufacturing the power-tiller transmission cover, and this development has been

passed on to the cooperating fabricators, along with the blueprints and prototypes.

At Reddy's suggestion, one of the more successful of the manufacturers made a unique modification to the thresher cover design by using hand riveting in place of welding. This modification distinguishs his thresher from those of other manufacturers, and reduces materials costs while nearly doubling the labor input.

3.4.4 Modifications Aimed at Salability

Most innovations in this area derive from efforts to set one's product apart from those of competitors. We saw a thresher model that was painted three different colors, whereas most are monochrome. A thresher model in Aceh came with safety covers for the otherwise exposed drive pulley. The effect on sales of these nonfunctional or safety-related changes is not known, but in a maturing market they may have a greater impact.

3.5 Farmer Feedback and Product Quality

The best test of a manufactured product is to use it under actual field conditions. In the case of the superstar manufacturers, contract services to farmers provide valuable feedback on thresher design. Other manufacturers report feedback from farmers. A few claim that their own ingenuity is the source of their innovations. Altogether, the range of innovations observed was quite promising, far more than were observed in the manufacture of the larger IRRI model TH-7 and TH-8 threshers in Thailand. One explanation for this is that the design of the TH-6 is deliberately simple, which encourages modifications to improve performance, whereas the larger models are less adaptable. Another is that IRRI-DITPROD and the Subdirectorate encourage adaptation to local conditions, and they themselves learn from it.

Clearly there is room for improvement in basic metalworking skills, as well as in structural design. Quality of welding is uneven; fitting and assembly are poor; finishing, although not critical, varies significantly. This suggests the need for technical skills training for nearly all of the fabricators and Government workshop staff as well.

3.6 The Role of Industrial Extension: Has It Made a Difference?

It has been noted that the most sustained effort has been made to introduce the IRRI-type thresher and to encourage both its local production and its use in West Sumatra. Over a period of 5 years, V.R. Reddy and his GOI counterparts identified fabricators and provided intensive technical assistance and training in the manufacture of the IRRI TH-6 thresher. They tested the products and assisted in field demonstrations and marketing. Although the earliest West Sumatran cooperator no longer makes the thresher, he served the essential purpose of providing an initial supply of reliable models in the area. There is evidence to suggest that other West Sumatran cooperators will remain in business and that their volume of production is expanding somewhat. At least three are expected to begin producing the IRRI-type power tiller for sale within the next 6 months to a year. Furthermore, there is enough diffusion occurring that IRRI-DITPROD often discovers other small thresher manufacturers after they have already initiated production by copying a local model. More often than not, these manufacturers then become "reactive" cooperators, receiving both technical assistance and training. It can be concluded that the IRRI TH-6 thresher has taken off in West Sumatra because of the intensive/reactive industrial extension effort to which V.R. Reddy was central. The success of the effort was enhanced by two key characteristics of the area: the industriousness and entrepreneurial nature of the Menangcabao people, and the fact that West Sumatra is a pronounced labor-shortage area where the agricultural wage rate is relatively very high.

The successes of the West Sumatra pilot effort have spread as far as North Sumatra and Aceh Provinces. These are target areas for the Subdirectorate's extensive approach to industrial extension, but not for IRRI-DITPROD. V.R. Reddy has visited only occasionally. Yet, several manufacturers have started to produce threshers. This can be attributed to three factors: (1) a considerable number of IRRI-type threshers, which were manufactured in West Sumatra and exported here, introduced the technology and served as models for copying; (2) IRRI-DITPROD and the Subdirectorate supplied provincial agriculture officers and manufacturers with blueprints and advice; and (3), especially in the case of Aceh, local provincial officials have supported the spread of the technology by providing substantial assistance to early producers in equipping workshops, applying production techniques, and marketing to both Government and private buyers.

Thus, the takeoff of the IRRI TH-6 thresher in West Sumatra fostered the spread of the technology to North Sumatra and Aceh in at least two important ways. First, it introduced the technology and provided a source of models; and second, it led to the development of a core of people at the national level familiar

with the products and experienced in the technology transfer process.

The introduction of the IRRI-type thresher and power tiller in West and Central Java occurred under substantially different circumstances. Two large manufacturers, one in Semarang and one in Yogyakarta, are now producing the tiller and thresher in fairly large numbers for distribution throughout Indonesia. Although they have utilized IRRI and other designs and some IRRI-DITPROD technical advice, they were already large manufacturers who simply added a new product line.

Another early cooperator in Bandung no longer manufactures IRRI-type machines. One large Jakarta manufacturer has not cooperated with IRRI-DITPROD, although the firm produces small-scale agricultural machinery and distributes it nationally on contract to the Government. Another Jakarta firm is an enthusiastic producer of power tillers as a sideline, but because of pronounced marketing difficulties the firm apparently has not sold many tillers. Thus, the effort to promote the manufacture and use of the machines more widely in Central and West Java does not appear to have succeeded. We can only speculate about the relative importance of two factors: (1) the fact that Central and West Java have not received the sustained, intensive assistance from IRRI-DITPROD that the pilot area of West Sumatra received; and (2) the fact that Java is a labor surplus area, characterized by very low wage rates and substantial underemployment and unemployment, both on-farm and off, which makes it a questionable target for "selective mechanization."

In conclusion, a picture emerges of a successful technology transfer effort managed by the GOI and IRRI project staff, which has introduced appropriate small-scale rice threshers into the West Sumatra pilot area and observed the diffusion to adjacent provinces. The technology has been appropriately designed and locally adapted for small-farm use and custom operations in part because it is appropriate for manufacture in small workshops in rural areas and provincial towns. Questions about the completeness of the transfer process are raised by the quality of work observed and marketing problems, points we will return to in Section 5. In the next section, we consider the policy and institutional climate in which the fabricators operate and technology transfers occur.

4. THE ENVIRONMENT FOR SMALL-SCALE AGRICULTURAL MACHINERY MANUFACTURE

The team observed considerable success in the IRRI-DITPROD project in fostering the technological development of small-scale

farm machinery fabricators in West Sumatra and adjacent provinces. The combination of intensive/reactive/extensive assistance (as described in Section 3) is an appropriate approach to introducing an agricultural technology and stimulating its use by farmers through its manufacture by local, small-scale industry. In addition, we observed independent technology adoption and noted the spontaneous development of manufacturing capacity.

These patterns of technology transfer and private enterprise development emerged in a policy and institutional setting which is examined in this section. We ask whether the GOI policy-institutional environment is conducive to the development of small-scale farm machinery manufacture by smaller workshops and village entrepreneurs, whether promoted through technical assistance or not. We review the current status and past and recent trends of agricultural mechanization in Indonesia, followed by a description of the institutional framework. (More detail on these topics is presented in Appendix D.) We then examine specifically the business environment for small-scale manufacturers.

4.1 Status of Agricultural Mechanization

The status of agricultural mechanization in Indonesia is best viewed within the context of the agricultural situation in the country. Agriculture accounts for 66 percent of the labor force, but only 30 percent of the gross domestic product. While plantation crops such as rubber, coffee, and sugar are important economically, rice is the single most important crop in Indonesia and the main crop of the vast majority of farmers. Thus, rice production provides the context for this study of small-scale farm machinery manufacture.

The practice of rice cultivation and the level of mechanization in the provinces visited is relatively similar to the situation in the rest of the country (see Table 4 and Appendix D, Sections 2 and 3). However, differences in rural population density are an important consideration. Densities are extremely high in Java, Madura, and Bali and relatively low in the Outer Islands. The biggest differences among the provinces are in labor availability and cost, as reflected in per capita income levels and farm labor wages. Daily wages are reported to vary from US$0.75 in Central Java to about US$2.00 in Sumatra. Obviously, this difference has important implications for future agricultural mechanization.

Table 4. Characteristics of Indonesian Provinces Visited by the Study Team

Characteristic	West Sumatra	North Sumatra	Aceh	West Java	Central Java	Yogyakarta	All Indonesia
General							
Population, 1980 (millions)	3.4	8.4	2.6	27.5	25.4	2.8	148
Population per km^2	68	118	47	593	742	868	77
Per Capita Income, 1979 (Rp)	-	118	205	88	71	63	112
Agriculture							
Wetlands Rice Area Harvest (1000's ha)	283	458	238	1,835	1,370	108	8,173
Wetlands Rice Production (1000's ha)	1,055	1,548	780	7,067	5,676	482	30,992
Wetlands Rice Yield (100 kg/ha)	37.3	33.8	32.7	38.5	41.4	44.5	37.9
Dryland Rice Area Harvested (1000's ha)	8	109	12	109	44	44	1,203
Dryland Rice Production (1000's t)	12	177	18	185	79	72	1,783
Dryland Yield (100 kg/ha)	15.5	16.3	15.4	16.9	18.1	16.6	14.8
Average Agricultural Wage (US$/day)	1.75	1.75	2.00	.75	.75	.75	1.00
Number of Power Tillers	550	200	300				
Crop Threshed by Power (%)	<15	<3	<10	<2	<2	2	2

Source: Indonesia Statistical Handbook, 1981. Data on mechanization and wage rates vary widely depending on the source and the frequency with which they are reported; therefore, the figures in this table should be considered as indicative only.

Although accurate data are not available,[14] it is clear that the level of agricultural mechanization in the country as a whole is very low for smallholder rice production. Aside from rice hulling, virtually all activities are done by hand or with draught animals, although power threshing is beginning to take off in some areas of Sumatra. One important development in harvesting was the replacement of the traditional knife (ani-ani) by the sickle, beginning in the 1970s.

There is a large potential market for mechanization of rice production, because most tasks have not yet been mechanized. However, effective demand, measured in terms of buyers ready and able to purchase equipment, is weak, perhaps because the vast majority of rice farmers operate less than half a hectare and about a third are tenants. At present, the market is shared by domestic and foreign producers. Although the majority of small threshers are now produced locally, mini-tractors and power tillers are generally imported. Locally made tractors tend to be expensive and of questionable quality. To meet present and potential future demand, considerable effort will be needed to develop the domestic tractor industry.

4.2 A Brief Review of the Government of Indonesia's Role in Developing Agricultural Mechanization

In the early 1950s, a mechanization unit was established with foreign assistance within the Ministry of Agriculture. Attention was focused on mechanization with four-wheel tractors and crawlers. In the 1960s, Japanese equipment was included as part of Japan's war reparations payments. The GOI gave the mechanization unit increased attention during its attempt to develop large mechanized public rice estates on the outer islands. However, with the failure of these estates, the importance attached to mechanization decreased, and the unit was eventually dissolved in a Ministry reorganization.[15]

During the latter part of the 1960s and the 1970s, various Chinese and Japanese rice transplanters and harvesters were tried by the Ministry, but were not officially field tested. Village-

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[14] The team made concerted efforts to obtain data on the status of mechanization in each province visited. Although some data were obtained, a quick review indicated that they were of questionable accuracy and not comparable across provinces.

[15] A.G. Rijk, Aspects of Appropriate Agricultural Mechanization Development and Priorities (in Indonesia) (Los Banos, Philippines: Regional Network for Agricultural Machinery, 1979).

level rice milling was implemented on a large scale in the 1970s.[16] Nonetheless, a UNDP/FAO effort to advise the GOI on policies and programs to promote mechanization was aborted because of insufficient funding and its preliminary recommendations were not implemented.

The last half of the 1970s marked the start of three programs of potential significance: (1) Indonesia was one of three countries selected for the IRRI research study of the consequences of small rice farm mechanization (see Section 1.1, footnote 3), with study sites in South Sulawesi and West Java; (2) IRRI's industrial extension outreach program began informally with the recruitment of V.R. Reddy, who would be stationed in Jakarta; and (3) Indonesia joined the Regional Network of Agricultural Machinery (RNAM), the UN-sponsored effort to assist countries in achieving agricultural mechanization through the promotion of local manufacture and the popularization of proven equipment (see Section 4.6).

4.3 Government of Indonesia Policy Toward Agricultural Mechanization

GOI agricultural policy, as articulated in the Third Five-Year Development Plan, 1979-1984 (Repelita III), is expected to continue essentially unchanged under Repelita IV (1985-1989). The goals are increased rural employment, farmer income, labor and land productivity, and food crop production, and support of rural development. Under Repelita III, the Government embarked on a new mechanization effort not only to develop new agricultural areas but also to increase agricultural production in areas where labor availability is a limiting factor.

The policy emphasis on rural employment generation derives from the current levels of unemployment and underemployment on Java, which are compounded by the fact the labor force is growing by more than 3 percent per year. This concern gives rise to an ongoing, though quiet, debate in GOI policy circles concerning the tradeoffs between agricultural mechanization and labor displacement. The result is that GOI policy concerning agricultural mechanization has not been clearly articulated. Thus,

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[16] Peter Timmer et al. have documented the spread of rice milling technology in a classic treatment of the policy and institutional forces involved in the choice of technology in Indonesia. (Choice of Technology in Developing Countries: Some Cautionary Tales [Cambridge, Massachusetts: Harvard University, 1975].)

although Repelita III calls for the Ministry of Agriculture to introduce farm machinery selectively in labor-shortage areas to increase production, other institutions may be out of step with this policy. For example:

-- BAPPENAS, the national planning agency, is reputed to be ambivalent about mechanization (see Appendix D, Section 4).

-- Ministry of Labor field staff promote job creation and appear to automatically oppose farm mechanization of any kind, even land-augmenting technology such as pumps.

-- From time to time BANPRES, a Presidential aid program, and the Ministry of Agriculture purchase both larger and small-scale agricultural machinery for distribution to model cooperatives and farmers.

-- The Ministry of Cooperatives has made a substantial effort to organize farmers into cooperatives and to provide them with credit to purchase rice milling units, tractors, and other machinery. However, the experience with cooperative machinery ownership has not been good, because repayment obligations are largely ignored. Nonetheless, the Ministry is a significant buyer of small-scale agricultural machinery, including some produced by IRRI-DITPROD cooperators, and the team visited one West Sumatra cooperative that manufactures IRRI-type threshers.

-- The Ministry of Transmigration wholeheartedly supports larger scale mechanization for use in initial land preparation in the newly settled areas outside Java. On the other hand, it has pushed for research on appropriate, affordable, animal-drawn equipment as an alternative means to mechanize new settlments in areas of labor shortage.

-- The Agency for Agricultural Research and Development within the Ministry of Agriculture includes five research institutes, among them the Central Research Institute for Agriculture which began mechanization research for transmigration areas in 1979. The current, limited Government research effort is focused rather narrowly on the impact of mechanization. Several universities also conduct mechanization research, but their efforts are not coordinated.

-- The Ministry of Agriculture established an Agricultural Machinery Testing Commission in 1976. The Japanese are proposing to construct a $8.5 million Center for the Development of Appropriate Engineering Technology for

DITPROD, which would include a workshop and testing center. The Subdirectorate for Agricultural Mechanization has approved the Japanese preappraisal report and forwarded it to BAPENAS, the central planning agency, for approval prior to final project development. As explained to the team by the Director of DITPROD, the Center "would be the same" as IRRI-DITPROD. However, the details on what additional technical assistance would be supplied are unclear, as are plans to expand beyond the Jakarta area.

In sum, despite continuing public debate over labor displacement, there are indications that the GOI has made a quiet, if modestly funded, commitment to selected mechanization in target areas, which will continue in its Fourth Five-Year Development Plan. The FY 1985 budget includes a twofold increase for mechanization over the previous year's, suggesting that the Government is according mechanization a higher priority. The Secretary General for Agriculture indicated in a meeting with this team that he favors the establishment of a Bureau of Planning for Agricultural Mechanization, with a broader perspective and stronger mandate than the Subdirectorate's.

However, the team is skeptical that the Government can actually control the adoption of mechanization, either geographically (restricting it to labor-shortage areas) or functionally (emphasizing machines geared to reducing postharvest losses). It is feared that once small-scale agricultural machinery manufacture has taken hold, the technology will sell itself whether or not it is appropriate. Therefore, given the difficulty of targeting mechanization, it should be anticipated that mechanization will also increase in Java and other labor-surplus areas, because some farmers view it as attractive, even when the prevailing wage rate for agricultural labor is low.[17]

The team accepts the argument that small-scale mechanization leads to increased land productivity and reduced postharvest losses. However, given the acute problem of unemployment and underemployment in Indonesia, it is imperative to stress the promotion of machines that reduce postharvest losses (e.g., the thresher, dryer, and rice milling unit) and those that are land augmenting (e.g., the axial flow pump) rather than those that are labor displacing.

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[17]Prestige of ownership and fewer labor problems may override financial considerations.

4.4 The Business Environment for Small-Scale Entrepreneurs

The business environment for fabricators of small-scale agricultural machinery is generally favorable, in spite of the current economic slowdown in Indonesia (which roughly parallels the worldwide recession). To counteract the recession and to shift away from an oil-based economy, the GOI has adopted a number of policies, such as a substantial devaluation, large increases in domestic fuel prices, an austerity budget, and credit and tax reform (see Appendix D, Section 1). These steps, which are generally applauded by international experts, do not adversely affect domestic manufacturers in the short run and will help them in the long run.

Although large enterprises seem to benefit most from GOI actions, a number of GOI policies and programs emphasize the development of small enterprises owned by pribumi (indigenous Indonesians). These include subsidized credit, technical assistance and training, Government procurement policies, and preferred licensing. The top-down programs are implemented by a variety of agencies and subject to considerable interpretation at the local level. As a result, programs are uncoordinated, provide services that are not needed, and often lack sufficiently trained personnel and budgets. Despite these weaknesses, programs are providing useful assistance to small enterprises.

Some GOI policies and actions provide strong incentives to fabricators of farm machinery. Starting in 1983, the GOI banned the import of hoes, hand sprayers, portable threshers, hand tractors, and rice milling units. Occasionally, BANPRES or the Ministry of Agriculture purchase large numbers of farm machines for distribution to "model" cooperatives and farmers in the labor-shortage Outer Islands. Also, banks are sometimes instructed to give "mass credit" to farmers for purchase of farm machinery.

4.5 Inputs Provided to Small-Scale Fabricators

Fabricators have little trouble obtaining necessary inputs. The general practice in Indonesia is for laborers to be trained on the job, so access to skilled labor is usually not considered a problem. Raw materials (basically steel) and imported components (engines, bearings, chains, etc.) are readily available in virtually all major provincial centers.[18]

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[18]A recent Government decision that all scrap iron must go to the Krakatua Steel Factory, however, may curtail the availability and drive up the price of this important resource for the makers of agricultural implements.

The need for technical assistance, training, and access to new designs is a problem that the GOI outreach programs are trying to overcome.

Credit for fabricators is not a serious constraint in most cases. A variety of formal and informal credit sources is available (see Appendix D, Section 5). However, the real cost of credit is high, averaging around 25 percent to 40 percent per year. Although some formal credit carries a nominal interest rate of 12 percent per year, the other costs (procedural requirements, ensuring favorable relationships with bankers, and so on) are high.

On the other hand, credit for farmers is a problem. Because they lack capital to buy farm machines, marketing is a serious problem, even though mechanical operations appear to be more economical than manual methods. The GOI has encouraged some banks to make loans for selective mechanization; however, banks are reluctant to extend credit because transaction costs and the perceived risks associated with making these small loans are high. The situation appears to be conducive to the purchase by small entrepreneurs of a piece of machinery such as a thresher, which they then rent to small farmers. These custom-hire operators reportedly can recover their capital investment in about 6 to 12 months and then reap relatively large profits. Although the number of operators is increasing, the supply is still less than demand, and thus operators earn excess profits. However, studies of custom-hire tillage suggest that actual operators may be losing money.[19]

4.6 Institutional Support for Small-Scale Manufacturers

Given the Ministry of Agriculture's mandate under Repelita IV to promote selected mechanization in target areas and the Japanese proposal to establish an $8.5 million Center for the Development of Appropriate Engineering Technology, it appears certain that the Ministry of Agriculture will continue to take the lead in promoting local manufacture of appropriate machinery for agricultural mechanization. Furthermore, the Ministry of Agriculture's relatively well-staffed network of extension

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[19]Hafsah, J., and R.H. Berstein, "Economic, Technical and Social Aspects of Tractor Operation and Use in South Sulawesi, Indonesia," in Consequences of Small Farm Mechanization (Los Banos, Philippines: IRRI, 1983), pp. 85-94; and Bunasor and Lingard, "Power Tiller Use on Rice Farms in West Java, Indonesia: An Analysis of Their Employment Effects and Private Profitability" (Los Banos, Philippines: IRRI, 1983) (mimeo).

workers is probably the only realistic avenue for delivering technical assistance to both farmers and manufacturers. However, a more formal role for the Metal Industry Development Centre (MIDC) is desirable, and inclusion of MIDC personnel in IRRI-DITPROD workshops should not be left to chance. Furthermore, MIDC's technical experts might be enlisted to improve the technical skills of the Ministry of Agriculture's national and provincial workshop staffs, as well as to supplement agricultural extension workers' efforts to assist manufacturers. Building in an increased and more formal role for MIDC would free agricultural extension workers somewhat to concentrate on promoting the products and instructing farmers in their proper use.

Although the Secretary General for Agriculture indicated that mechanization would be an element of Repelita IV and expressed his interest in elevating responsibility for it within the Ministry, the GOI commitment to IRRI-DITPROD and the Subdirectorate is not impressive. The Subdirectorate budget is small and its staff is overtaxed. Despite V.R. Reddy's tireless efforts to promote IRRI-DITPROD, he has had difficulty keeping his engineering and technical jobs filled with suitable staff and recently had to turn to two young British Overseas Volunteers to provide him with the technical support he needs to adapt prototypes and augment the capabilities of the Bukittinggi workshop.

ALSINTANI, the Indonesian Agricultural Machinery Association, represents producers of agricultural machinery, including several of the larger IRRI cooperators and MIDC. Its interest is in creating a favorable business environment for the development of a domestic agricultural machinery industry. In this capacity, it endorsed recent bans on the importation of certain agricultural machines. To date, its only office is in Jakarta, which essentially precludes small regional manufacturers from membership.

The team visited other development projects aimed at promoting provincial development and small-scale enterprise development, but none was directly geared to small-scale farm machinery manufacture. The Central Java Provincial Development Project proposed feasibility studies for agroprocessing and metalworking industries, but this has not progressed beyond the talking stage.

The Regional Network for Agricultural Machinery (RNAM) assists Indonesia in achieving agricultural mechanization through the promotion of local manufacture and the popularization of proven equipment. It has no workshop or field activities, but provides DITPROD with prototypes for its workshop from other countries in the network and sponsors seminars and training. Despite its well-publicized activities, the study team saw little

evidence of any significant impact from this channel of technology transfer, and none at the level of the small-scale enterprises producing farm machinery.

RNAM's most prominent role is to promote national committees for mechanization policy. A Joint National Farm Mechanization Committee is chaired by the Secretary General of Agriculture. It includes representatives of relevant ministries, research institutions, and the private sector. However, it does not have permanent staff or a discrete budget as yet, a lack of support which is reflective of the overall policy climate.

5. CONCLUSIONS AND LESSONS LEARNED

The following summary of conclusions and lessons learned primarily addresses the issues of sustainability and replicability, because the series of Special Studies of which this is a part is intended to identify approaches to promoting sustained private sector growth that can be adapted for use in other geographical settings and other sectors. Because this is not a project evaluation per se, we have not directly addressed the issue of how USAID/Jakarta might apply these lessons to a follow-on project. It should be clear, nonetheless, that the team found the industrial extension efforts to be worthwhile and the approach worthy of continuation.

5.1 Conclusions About Economic Impact

5.1.1 Production Linkages

Our findings on the issues of backward and forward linkages of small-scale agricultural machinery fabricators to the Indonesian economy are inconclusive. The small-scale fabricators revealed little subcontracting activity, either to acquire components or to supply components to other manufacturers. The diesel engine manufacturer, Kubota Indonesia at Semarang, has received considerable recognition for establishing its backward linkages to small suppliers, but this is a significantly different category of subcontracting and well beyond the scale of fabricators to which production of IRRI-type farm machinery is geared.

Because of the small number and early growth stage of IRRI-DITPROD cooperators, forward linkages of the firms also are insignificant for the majority of small farm households insofar as income generation and off-farm employment creation are concerned. However, there is a marked forward linkage effect for the initial adopters of threshers who secure windfall profits

through contract services and will continue to do so until the custom-hire market is saturated.

Thus, to date the overall economic impact of the manufacturing activity is hardly measurable, and it is not likely to be significant for some time. Even as the technology spreads, there is not likely to be much of a direct employment or income effect from these enterprises because of their small scale.

However, the level of skills of the workers engaged in fabricating IRRI-type machinery is bound to improve, and this effect is important to the general level of small-scale industry, especially if the GOI pursues its recently announced policy of increasing Government purchases from small industry. We observed that the age and prior training of workers was fairly high (compared with workers in similar enterprises in Thailand, for instance, although quality of work appeared to be lower). This suggests that there is considerable room for skills improvement in metal fabrication.

Lateral linkages include the "fission" process, whereby employees leave an established manufacturer to start their own similar business. We encountered little evidence of this splitting-off process. Notable exceptions were a superstar firm in West Sumatra, which is owned by a machinist employed in the Bukittinggi Government workshop, and a family firm in that area which reported a high worker turnover, with 75 percent of its mostly younger employees leaving. The farm machinery industry is still in an early stage of growth, and thus it is too soon to assess the fission process.

There are several other, less tangible linkages that may be significant. Although their measurement is premature and beyond the scope of this study, they merit consideration.

First, an important linkage from users back to the manufacturing sector involves the readily observable lesson of import substitution. Both the Indonesian Government and some elements of the private sector now believe that locally manufactured products can meet their needs. Such products are less costly and easier to maintain and repair than imported machines. Provincial agricultural officers described the bitter experiences of new owners of imported machines who tried to maintain their equipment when the initial stock of spare parts ran out. Many West Sumatrans now recognize that local manufacture of farm machinery is feasible and that the problems of imported equipment (high initial costs, nonavailability of spare parts, high level of complexity) can be largely circumvented. This could well carry over into postharvest machinery manufacture and to locally manufactured rural transport technologies.

Second, the technologies thus far introduced have had diverse downstream and multiplier effects in different regions. For example, according to V.R. Reddy, the axial flow pump facilitates year-round navigation on a network of narrow channels that provide the only means of transport in the swampy areas of South Kalimantan. In the Luwu district of South Sulawesi, farmers reportedly use the power tiller with a locally made trailer for rural transport. The impact of reduced threshing time on West Sumatra cropping intensities is not yet verified, but it could lead to greater land utilization and increased overall production in irrigated areas. Thresher users will benefit from lower production costs and decreases in postharvest losses. Similarly in North Sumatra and Aceh Provinces, widespread reduction of postharvest losses and improvement in grain quality promised by more timely mechanical threshing would affect the local economy positively.

5.1.2 Constraints to Increased Production

In labor-shortage areas, effective demand for the TH-6 thresher and other IRRI-type machinery is depressed by poor marketing practices and a lack of access by farmers to credit. Elsewhere, demand is depressed by prevailing low wage rates for agricultural labor. Interestingly, the availability of credit to manufacturers has apparently not been a significant problem, although they would prefer access to cheaper money.

Improved marketing practices could include more widespread reliance on manufacturer contract threshing or tilling (as a means of generating income while demonstrating the product) and extension of credit by manufacturers to their clients. Alternatively, given the lack of business know-how of the typical small-scale manufacturer of agricultural machinery, it might be worthwhile to pursue other avenues to sales and distribution, for example, commercial marketing distinct from production. However, to minimize any adverse impact on the agricultural labor market, the technology should generally be allowed to sell itself and marketing should grow with manufacturing capabilities. If the Government were to subsidize production and/or buy and distribute large quantities of agricultural machinery, the result would probably lead to domination of the market by large Government-oriented firms that are not generally responsive to local conditions or service oriented. It would also run the risk of inappropriate adoption of mechanization and of subsequent labor displacement.

5.1.3 Private Sector

Although it is premature to assess its cost-effectiveness, IRRI-DITPROD and the Subdirectorate have demonstrated a successful public sector approach to transferring technology to the private sector. As a direct result of IRRI/GOI intensive and extensive technology transfer efforts in Sumatra, reactive and independent transfers have taken place as other manufacturers and repair shops copy threshers that they see operating or that they repair. An extremely important outcome of this successful technology transfer effort is that both the GOI and some elements of the Indonesian private sector now believe that a locally manufactured product can meet their needs and that it is less costly and easier to maintain than imported machinery.

Nonetheless, much of the Indonesian private sector remains geared toward importation of agricultural machinery rather than domestic production. Furthermore, despite requirements for locally supplied components in domestically assembled products, there is not yet substantial evidence that importers and large domestic manufacturers are promoting technology transfer to subcontractors to any signficant degree.

5.2 Conclusions About Technology Transfer

The IRRI/GOI effort to promote the manufacture and use of small-scale agricultural machinery generally has been successful, as indicated by the following factors:

-- Government data and the testimony of extension workers, manufacturers, and farmers indicate that there is a good potential market, in selected areas, for the thresher and possibly other IRRI-type machines, especially those geared to reducing postharvest losses.

-- Small manufacturers are capable of producing an adequate IRRI TH-6 thresher and of successfully adapting it to local conditions; however, the IRRI power tiller may be underdesigned for local conditions, with the result that Indonesians prefer to import and copy other models.

-- As a result of IRRI-DITPROD's efforts, there is evidence that the IRRI TH-6 thresher is spreading throughout Sumatra and significant technology diffusion is occurring in the West Sumatra pilot area, as well as neighboring North Sumatra and Aceh. However, even in naturally receptive Sumatra, it clearly takes time to introduce a new technology and promote its manufacture and use.

The team further considered the process in terms of the following basic questions concerning the transfer of local manufacturing technology.

5.2.1 Is the Technology Appropriate?

-- The IRRI TH-6 thresher has proved appropriate for local manufacture in small workshops, because the labor-intensive manufacture requires little capital or equipment for fabrication and assembly. Thus, the level of technology transferred is readily adopted by small-scale entrepreneurs. All of the machinery can be built in small workshops with light metal cutting, bending, and welding tools, and a minimum of purchased components.

-- The IRRI PT power tiller requires more precision machinery if the power train is to be durable. Workshops must work to closer tolerances, and machining on a lathe is necessary for critical components. Therefore, the IRRI-DITPROD approach of first supplying the assembled transmission, and then supplying necessary jigs and fixtures seems valid, although there is not yet much experience with promoting tiller manufacture.

-- The axial flow pump produced by a large Jakarta manufacturer has spread only in West Java and South Kalimantan, despite demonstrations by IRRI-DITPROD and the Subdirectorate in other project areas. The lack of success in Sumatra remains a mystery, since the axial flow pump is land augmenting and the IRRI type could be easily fabricated in small workshops, provided the propeller, shaft, and bearing can be purchased.

-- Prototype rice dryers have been built by IRRI-DITPROD, but dissemination has only begun, although it is a priority of the Subdirectorate.

5.2.2 Is the Technology Transfer Process Complete and the Level of Effort Appropriate?

-- Local manufacture of IRRI-type equipment has been started by firms that vary in size, market orientation, and commitment to sustained small-scale agricultural machinery manufacture. IRRI-DITPROD technical assistance has been tailored well to each type.

-- The level of effort expended on getting the fabrication process underway appears to have been necessary.

However, it is doubtful whether the Subdirectorate, let alone IRRI-DITPROD, can continue to provide long-term assistance of this intensity in new pilot areas, unless resources, including expatriate technical assistance, are expanded considerably.

-- The emerging entrepreneurs (or superstars) and family firms seem to benefit most from intensive assistance. Firms that produce the machinery as a sideline and those whose primary orientation is toward the Government market need only extensive assistance to ensure product quality and fair marketing practices.

-- Because it is difficult to ascertain a priori which small entrepreneurs will emerge as superstars, a reactive technical assistance approach, followed by intensive assistance to emerging successful manufacturers, better utilizes scarce resources.

-- Technology transfer has occurred spontaneously and independently as local manufacturers copied and introduced the machines within the project areas and in adjacent provinces. This is further evidence of the appropriateness of the technology, that is, simple designs which are easily copied. Improvements are also being made in traditional designs such as the pedal-powered, wire-loop thresher observed by the team in Central Java. These independent initiatives are encouraged by IRRI and the Government.

5.2.3 Is the Technology Transfer Package Complete?

-- IRRI-DITPROD approaches marketing assistance to manufacturers in two ways: by stimulating demand through field demonstrations of the machinery and by training manufacturers in simple business management. It is unclear, however, that the latter has been adequate and it may be advisable to bring in expertise from the fields of industry and finance.

-- Although the technology transfer process in Sumatra is generally successful, further agricultural engineering assistance and industrial training for fabricators are essential if "technology mastery" is to be achieved, especially as more complex machines such as the power tiller are introduced.

5.2.4 Are the Appropriate Institutions Involved in the Transfer Process?

-- The institutional base for the IRRI/GOI industrial extension effort could be broadened formally to include Ministry of Industry industrial extension workers and MIDC, leaving the Subdirectorate to concentrate on feasibility studies at the farm level, education of field personnel, and popularization of the IRRI-type machinery, without the competing demands of providing manufacturing know-how and production management skills.

-- However, MIDC's budget resources are insufficient and the Ministry of Industry's industrial extension staff do not now generally extend to the district level. Therefore, it may be more feasible to improve the skills of the Ministry of Agriculture's network of extension agents than to try to coordinate service delivery by the two ministries.

5.3 Conclusions About the Government of Indonesia Policy and Institutional Environment

5.3.1 Policy

Government policies for promoting the manufacture and use of small-scale agricultural machinery are generally supportive but weakly articulated. Certain policies and programs create incentives for manufacturers of small-scale agricultural machinery, including the following:

-- Large pribumi (indigenous Indonesian) credit programs

-- Recent bans on the importation of certain agricultural machinery and implements (e.g., portable threshers, sprayers, mini-tractors, and rice milling units)

-- Substantial purchases and distributions of farm machinery by BANPRES, cooperatives, and other Government agencies

-- The Bapak Angkat program to encourage subcontracting

-- A large devaluation that gave domestically produced agricultural machinery a price advantage over imports

Policies and programs creating disincentives for manufacturers of small-scale agricultural machinery include the following:

-- The widespread concern over rural unemployment and underemployment, which translates in some quarters into resistance to mechanization (even that which is not labor displacing)

-- Low budget allocations for the Subdirectorate for Agricultural Mechanization

-- Ambiguous bureaucratic interpretations of national mechanization policies at the local level

-- The emphasis on "selective mechanization for targeted areas," that is, restricting farm mechanization to certain machines and to desired geographical areas, which may make sense but is not likely to be enforceable

-- The recent decision that all scrap iron will go to the giant Krakatua Steel Company, which will reduce the supply and drive up the cost of raw materials for small-scale implement manufacturers

5.3.2 Government Programs

GOI programs that support the small-scale industry as a whole are poorly coordinated, resulting in substantial gaps in service at the local level. Among the consequences are the following:

-- Many GOI agencies are involved in or have taken a position on agricultural machinery use and supply (by import or local manufacture), including the Ministries of Agriculture, Industry, Transmigration, Manpower, Trade, Cooperatives, and Planning, as well as the banking system and BANPRES. Some actively promote mechanization, whereas others automatically oppose it because of the labor displacement threat.

-- The Joint National Farm Mechanization Committee rarely meets, and without staff or budget, it does little to communicate or coordinate the various mechanization activities of participating GOI and nongovernmental agencies.

-- At both the national and local levels, formal and informal communication concerning mechanization is weak, and formal coordination among programs is almost nonexistent.

-- Coordination of agricultural mechanization activities within the Ministry of Agriculture is poor. While some branches are promoting local manufacture, others make large purchases of both imported and domestic equipment, often without consulting the Subdirectorate for Agricultural Mechanization.

-- There is little evidence of formal coordination between the Ministries of Agriculture and Industry outreach programs to assist small manufacturers. The Ministry of Agriculture has an active program at the district level, whereas the Ministry of Industry, which has greater technical expertise in the area of metal manufacture, focuses more on large industry and does not consistently reach small fabricators.

5.3.3 Mechanization

Complete congruence has not been achieved between Subdirectorate and IRRI-DITPROD priorities for agricultural mechanization. Among the areas where policy is not coordinated are the following:

-- The GOI currently accords the highest priority to machines geared to reducing postharvest losses (e.g., the thresher, dryer, and rice milling unit).

-- IRRI-DITPROD, however, has concentrated its effort on the thresher in Sumatra, followed by attempts to introduce the power tiller in Java, West Sumatra, and South Sulawesi, and the axial flow pump in South Kalimantan.

5.4 Lessons Learned

5.4.1 Sustainability

It is too early to generalize about the sustainability of the manufacture of small-scale agricultural machinery by small firms. There is some evidence, however, that sideline manufacturers, although effective at quickly producing acceptable models, do not find small-scale agricultural machinery manufacture sufficiently attractive to sustain production of IRRI-type

machines. By the same token, Government-oriented manufacturers appear likely to continue producing small-scale agricultural machines only as long as they have an assurance of Government demand. On the other hand, superstar and small family businesses, having made the initial investment in the technology, are more likely to stay the course, assuming continuing demand by farmers for their products.

One lesson learned from this is that the overall business environment for fabricators must be favorable. The GOI has taken a hard look at its policies with a view toward encouraging entrepreneurship. As a result, a 1983/1984 ban imposed on the importation of certain farm tools and machinery (hoes, hand sprayers, portable threshers, hand tractors, and rice milling units) now protects the domestic market while the small firms start up in the business and master the simple IRRI-type technology.

5.4.2 Replicability

Much of the IRRI/DITPROD project's success stems from the enthusiasm and commitment of the project officer in his work with the local entrepreneurs. V.R. Reddy's commitment has benefited fabricators in several ways. Because he previously owned a small-scale agricultural machinery manufacturing firm in India, he has been able to apply general business and engineering skills in assisting manufacturers with design and marketing problems, while encouraging their innovativeness and stressing the need to adapt equipment to local conditions. In addition, he has encouraged Government bureaucrats, by his own example, to work more intensively with small entrepreneurs and has successfully lobbied Government officials for policy changes more favorable to private enterprise development of the industry.

Although it is still too early to assess the cost effectiveness of this industrial extension effort, it seems safe to venture that the general approach is replicable in other Indonesian provinces and, with some modifications, in other developing countries. An important consideration is the baseline level of rural metal fabrication in the area and the sophistication of the fabrication process, assuming the equipment is appropriate for the mechanization needs of the area.

The team has doubts that the GOI can enforce its policy of "selective mechanization in targeted areas." Once agricultural machines with interchangeable engines have been introduced, farmers are likely to seek preharvest as well as postharvest technologies. Mechanization is also likely to spread to labor surplus areas, because it offers certain advantages that may offset the low prevailing wage rates for agricultural labor.

The lesson learned is that developing country commitment to a clearly articulated policy and program for mechanization must exist. One of the major development goals of the Indonesian Government is an emphasis on rural employment because of the severity of current unemployment and underemployment on Java and Bali. The situation is compounded by the more than 3-percent annual increase in the labor force. This emphasis gives rise to an ongoing, sometimes controversial, debate in Government policy circles concerning the tradeoffs between agricultural mechanization and labor displacement. The result is that Government policy concerning agricultural mechanization is unclear. In one provincial capital, the team noted that ambiguous bureaucratic interpretations of national mechanization policies have resulted in provincial-level reluctance to disburse credit to small farmers who wish to purchase equipment.

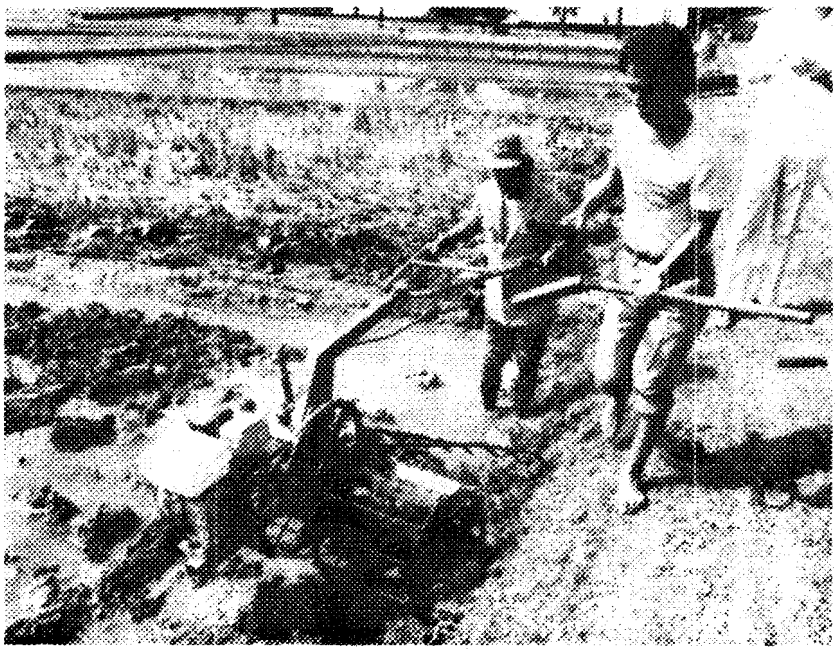
Furthermore, appropriate coordination among and within the principal ministries supporting this farm mechanization is essential. A stronger country program can then evolve with better concentration of effort. Services to the industry would be more cost effective and timely.

We are not optimistic about the replicability of this approach with respect to technology transfer to nonagricultural manufacturing activities. The small-scale agricultural machinery subsector is both a manufacturing industry (fabrication) and a service industry (repairs, overhauls, custom-hire operations, and so on). Because of this critical linkage and the fact that the equipment must be adapted to meet local conditions, the arguments for a dispersed small-scale agricultural machinery industry outweigh the countervailing argument for greater economies of scale offered by more concentrated production. This principle is embodied in the IRRI philosophy. Because we can think of few manufacturing fields other than agriculture in which fabrication and service are so closely linked and which are so dependent on local adaptation of design, we hesitate to endorse the IRRI-DITPROD strategy as a general approach for promoting the development of small-scale industry.

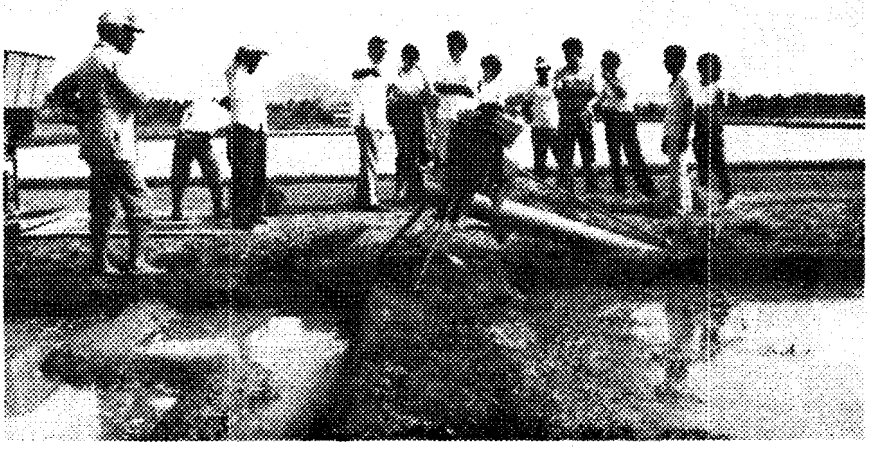
In conclusion, the study team believes that this project has clearly increased the Indonesian capability to design, adapt, and produce mechanical technology that previously was imported or not available. Although the effect to date has been small relative to foreign exchange savings, increased farm incomes, and off-farm employment generation, the long-term benefits should be significant. Private ownership of small farm equipment manufacturing enterprises is proving to be a successful venture. It has helped to provide Indonesian farmers with locally adapted, low cost, easily maintained agricultural machinery.

APPENDIX A

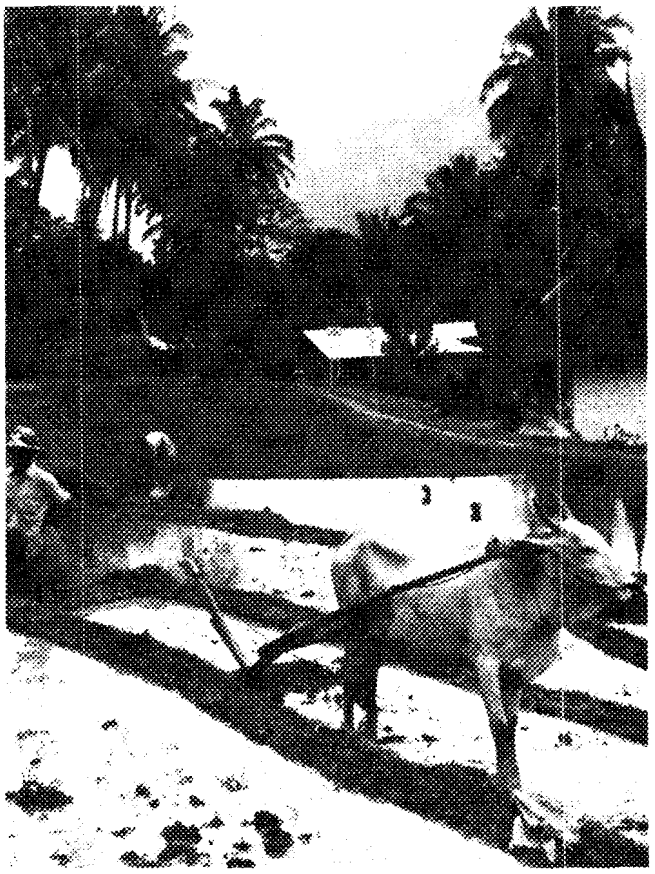
PHOTOGRAPHS OF IRRI-TYPE FARM MACHINERY AND INDONESIAN FABRICATORS



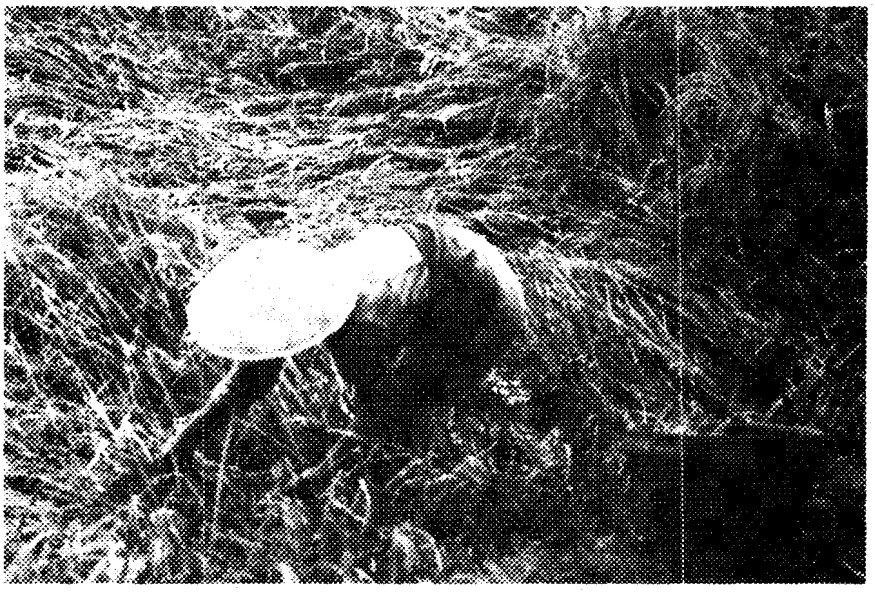
Demonstration of the two-wheel tractor at IRRI, Los Banos, The Philippines.



Demonstration of the IRRI low-lift water pump at Los Banos.



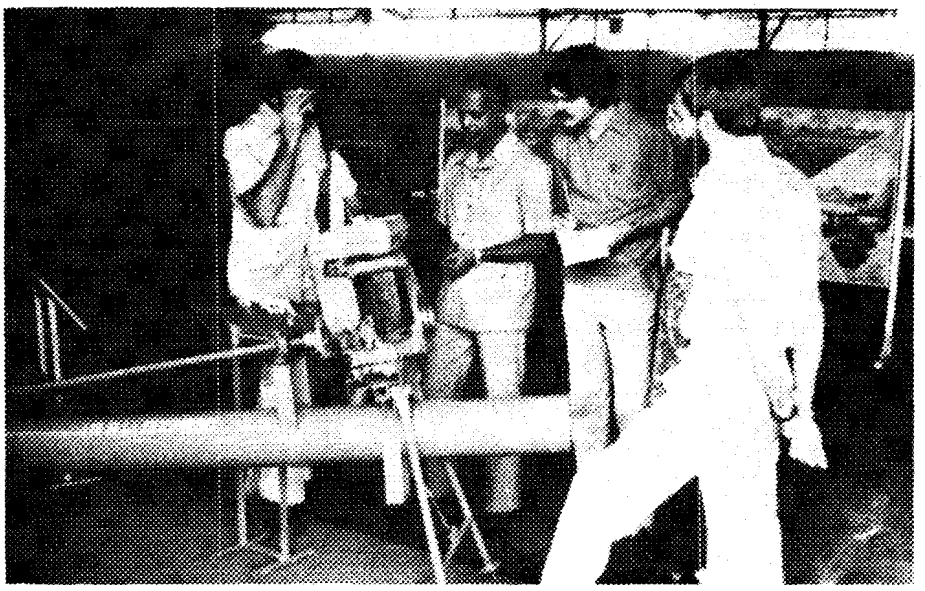
Traditional ox cultivation of rice paddy, W. Sumatra.



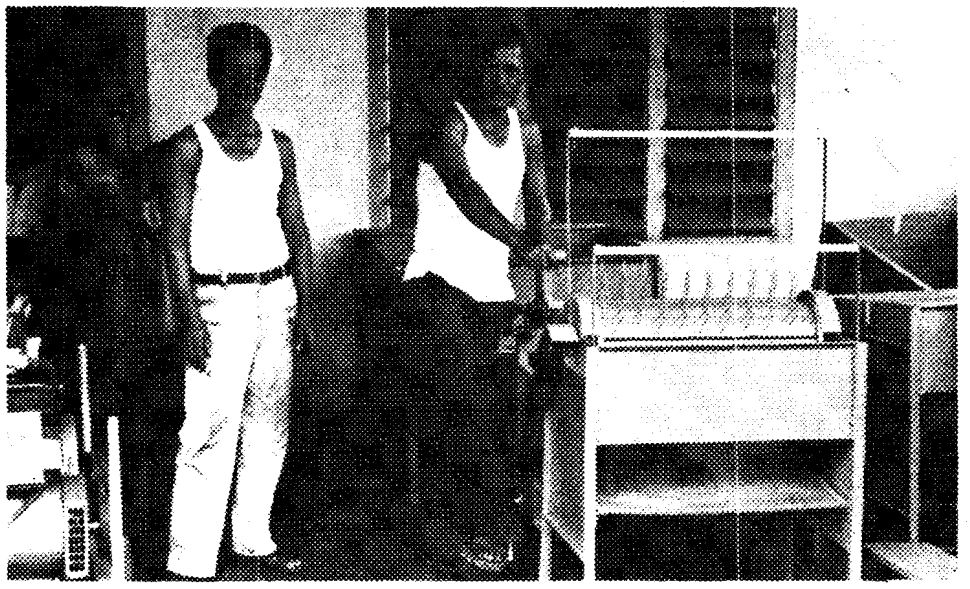
The traditional harvest of rice by hand knife, near Central Java.

Traditional threshing of rice near Padang, W. Sumatra.

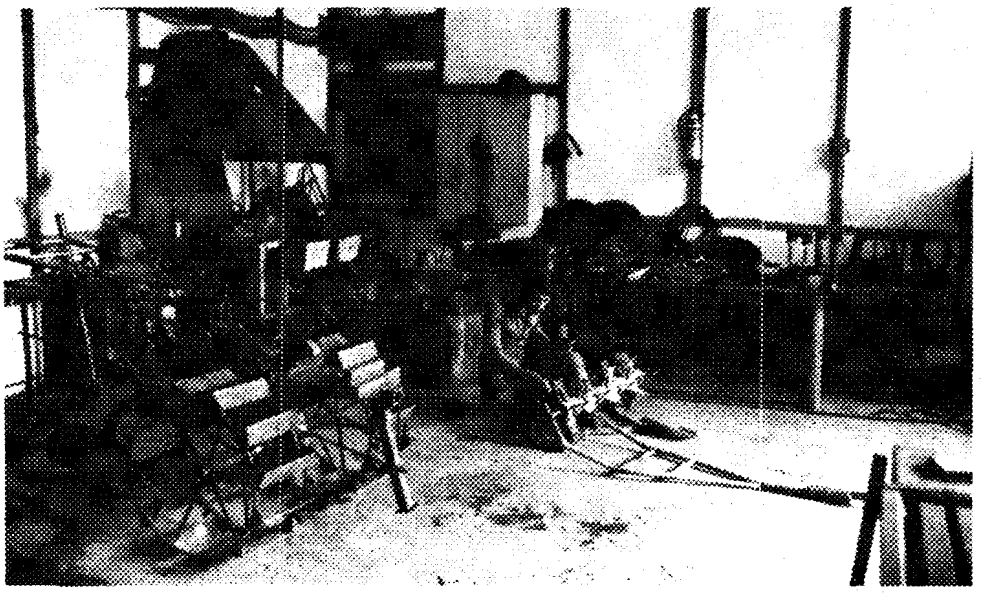
The IRRI rice thresher operating in adjacent field, near Padang, W. Sumatra.



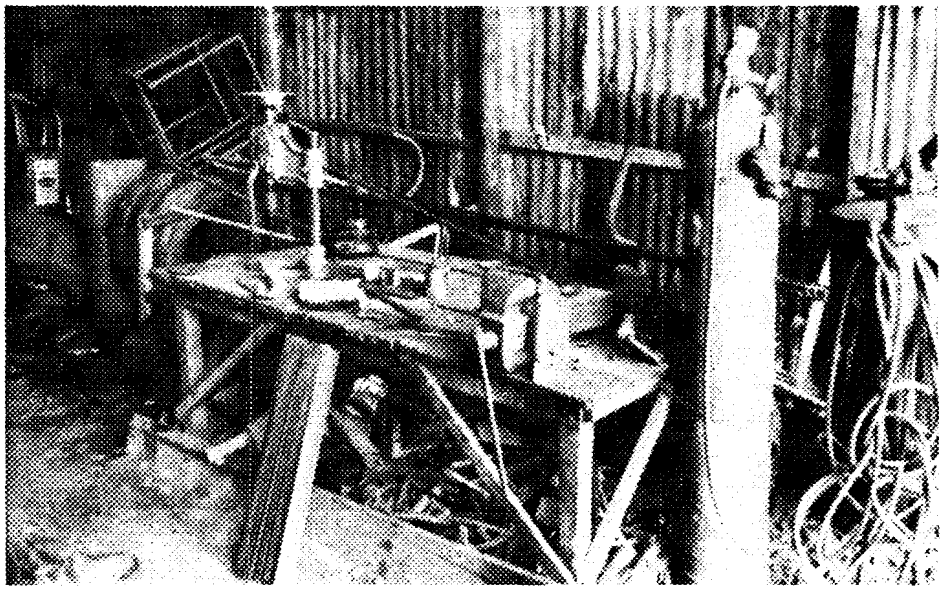
The IRRI-Ditprod Workshop near Jakarta, V.R. Reddy, IRRI advisor in Indonesia is second from the left.



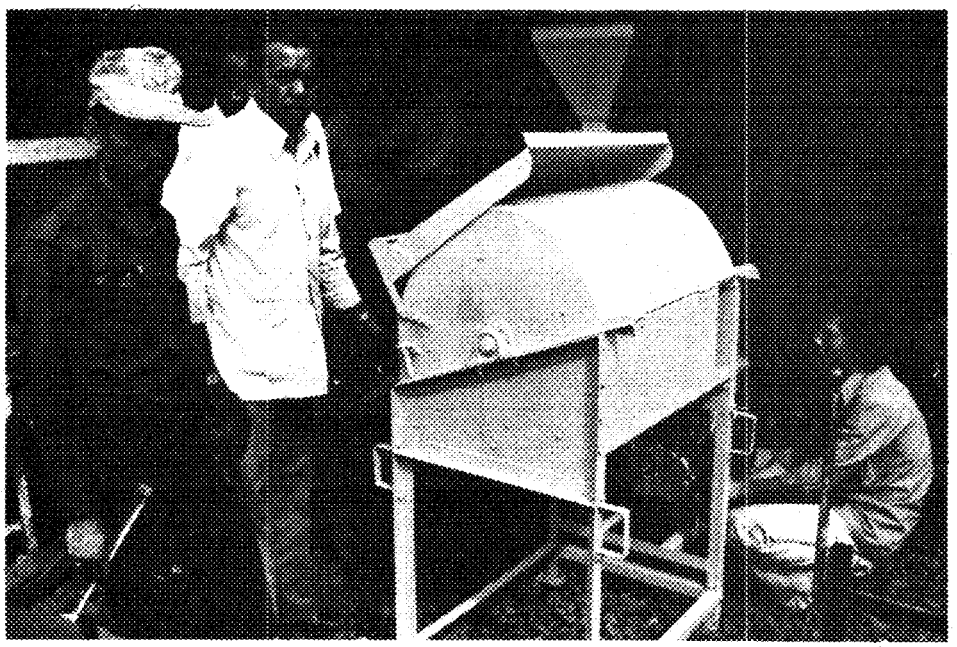
A peddle-operated wire loop thresher manufactured in N. Sumatra.



The Government Workshop at Bukittingi, W. Sumatra.

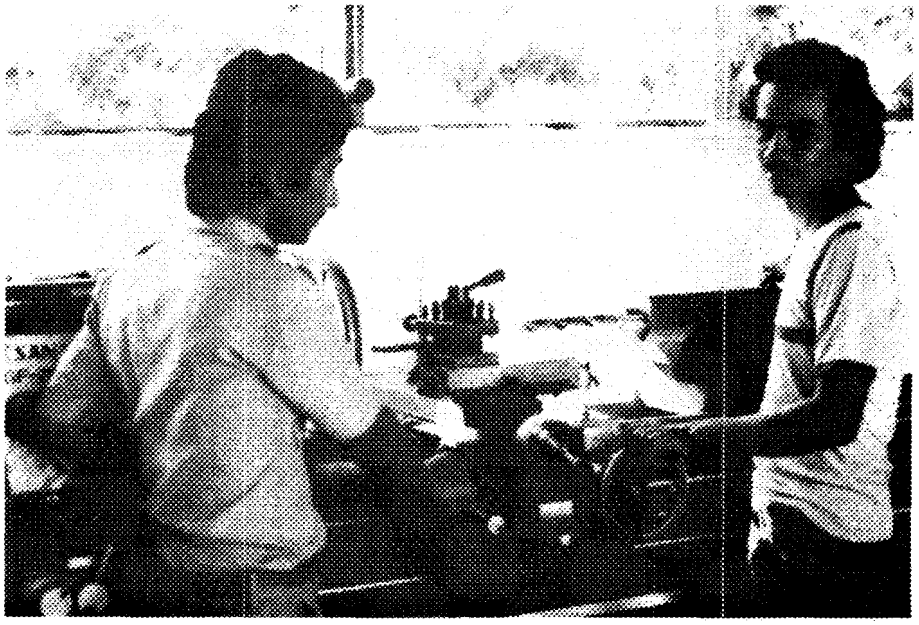


A "family" firm near Bukittingi, W. Sumatra.

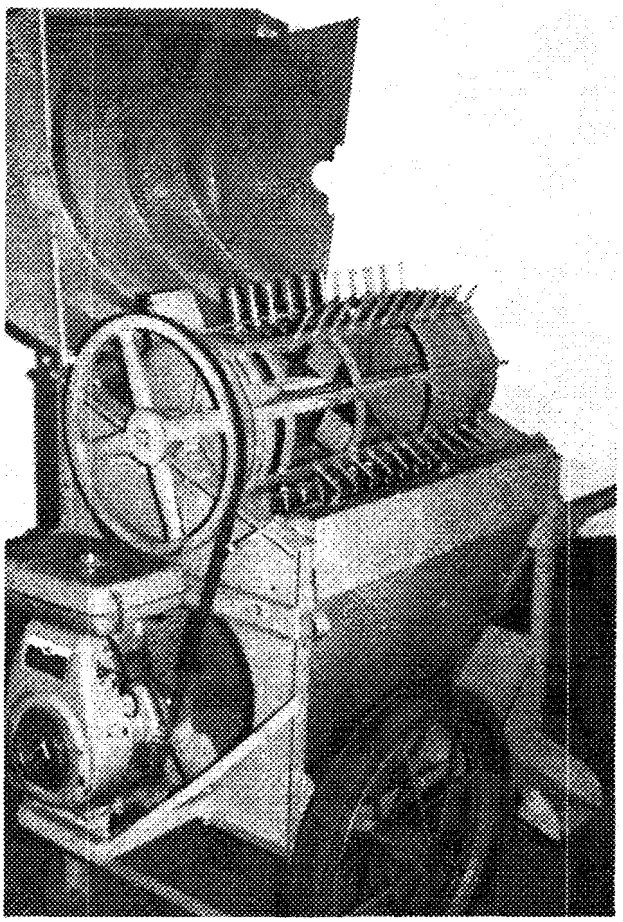


A "sideline manufacturer" near Bukittingi, W. Sumatra.

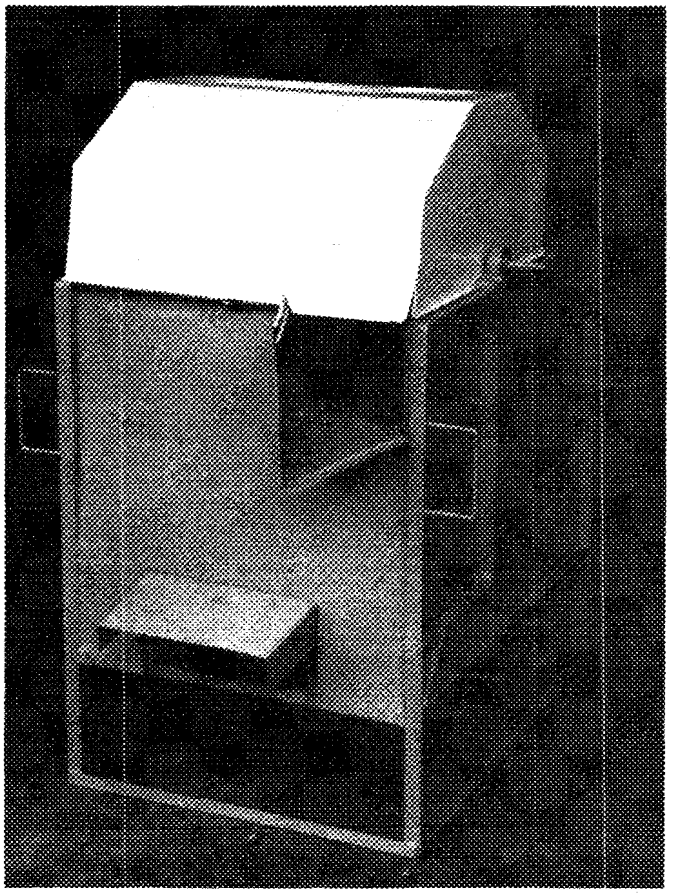
Operator using jig and fixture in fabrication process at a "government-oriented enterprise, Banda Aceh.



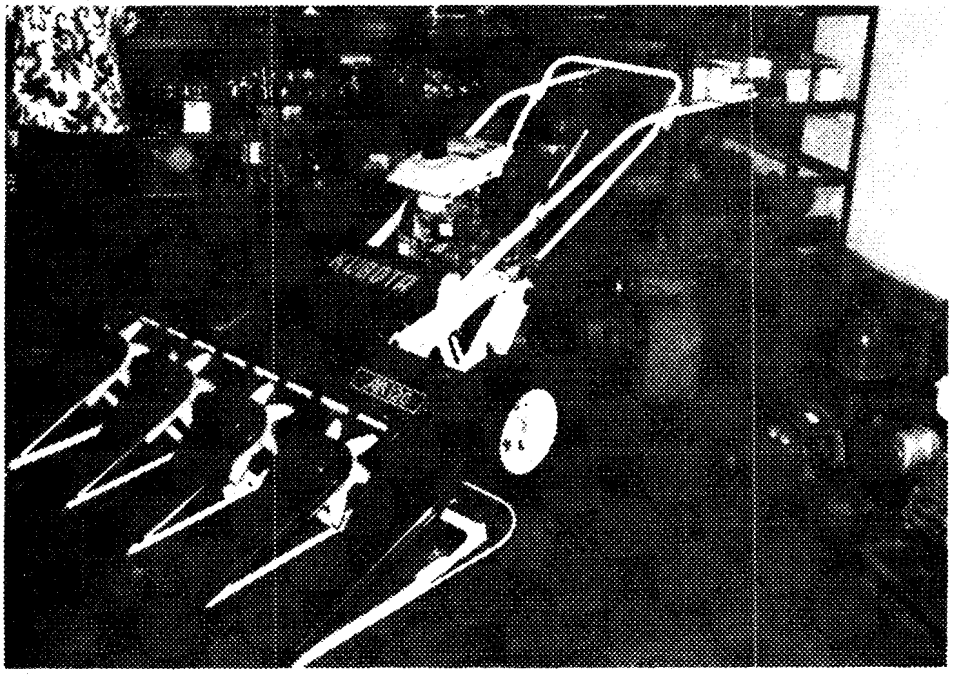
One of the four "Superstar" manufacturers, or outstanding performers near Bukittingi, W. Sumatra.



The rice thresher on wheels manufactured by a "Superstar" firm.



A thresher manufactured by a "government-oriented" firm near Medan.



A Kubota vertical reaper on two wheel tractor on display at a large firm in Yogykarta.

APPENDIX B

AID PROJECT BACKGROUND

1. PROJECT RATIONALE AND HISTORY

The International Rice Research Institute (IRRI) was established in the Philippines in 1960 by the Ford and Rockefeller Foundations in collaboration with the Government of the Philippines. Its original purpose was to conduct research on rice to improve quality and increase output. Subsequently, the Agency for International Development (AID) contributed funding to this effort. IRRI's efforts led to increased rice production in countries using the newly developed varieties.

To permit farmers to increase rice output still further and to expand local labor-intensive manufacturing, IRRI, with AID assistance, embarked on a research and utilization endeavor to develop low-cost, small-scale agricultural equipment using materials available in local markets. From 1965 to 1974, AID contributed US$1.4 million, with the result that 37 prototype machines were developed, of which 16 eventually were released for manufacture in the Philippines (including the axial flow thresher, batch dryer, power tiller, four- and six-row weeders, and seed cleaner). Although the research and development (R&D) aspect of this follow-on program was generally considered to be productive, there was a lack of success in promoting the manufacture and distribution of the equipment outside the Philippines.

The failure to duplicate the early Philippine successes elsewhere in Asia was attributed to the lack of close linkages between IRRI's contract technicians and local manufacturers. Limited manpower, as well as distance and cost factors, prevented efforts in other countries from receiving the level of attention that the program apparently required for successful implementation. Nonetheless, it was thought that most of the machines developed under the IRRI program had widescale application within Asian rice producing countries and that adequate manufacturing capacity existed in most of them, especially if the machines were tested locally and adapted to fit local conditions and the manufacturing limitations of local enterprises. Furthermore, it was evident that throughout the area, mechanization was occurring rapidly through the import of larger, more sophisticated and more costly machines and joint ventures that produced copies of Western models locally. Although these machines were generally adequate, some problems remained. Major gaps existed in the type and availability of equipment required in the rice production cycle, and the imported equipment was difficult to maintain and was accessible only to the more affluent, larger farmers.

Because of these factors, AID's Technical Assistance Bureau (now the Bureau for Science and Technology) developed the industrial extension project to take maximum advantage of the potential for increasing rice production in Asia afforded by coupling the local manufacture, marketing, servicing, and use of appropriate small-scale agricultural equipment with the use of improved seed varieties and cultivation practices. To achieve this goal, the project drew on the experience of AID/IRRI in the Philippines, where the establishment of a close working relationship between local manufacturers and IRRI engineers led to effective transfer, adaptation, and acceptance of IRRI-designed machines. Within IRRI, the project has been the responsibility of the Engineering Department, which was begun in 1965 with funding from the core budget. Organizationally it is on a par with the research departments in agricultural economics, entomology, and cropping systems. An engineering extension office, established 10 years later to provide extension services for machines developed by the Engineering Department, has established outreach offices in countries participating in this project.

When the project was designed, it was considered essential to provide business management assistance, including advice on general organization and financial management, marketing, sales and distribution, the introduction of cost and inventory controls, and so forth, alongside IRRI engineering expertise. For this purpose, IRRI subcontracted with the Georgia Institute of Technology to provide essential support services to ensure the continued viability and profitability of the manufacturers.[1]

The Industrial Extension of Small-Scale Agricultural Equipment Project was approved in 1975 for 3 years at a total cost of US$839,000. Under the project, AID provided funding for technical assistance to develop prototype designs and to provide business and management expertise, farmer orientation, training of manufacturers and host country personnel, and some equipment, in addition to core support for IRRI. The basic criteria for selecting the technology for development and extension efforts were (1) that the machinery be simple and inexpensive to build in small, general purpose workshops and (2) that it be easy to operate, repair, and maintain in rural areas. The original participating countries--Pakistan, the Philippines, and Thailand--were to provide land and technical, budgetary, and in-kind support. Despite substantial delays in initiating implementation

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[1]This arrangement for IRRI contract engineers to provide the agricultural and technical expertise and Georgia Institute of Technology subcontractors to provide business and managerial support ended in 1980; thereafter IRRI contractors alone have provided support.

in Pakistan and Thailand, the country teams made significant progress in the early years. Approximately 30,000 machines based on IRRI designs were produced during 1976, and the number of manufacturers producing IRRI-designed machines on a commercial basis increased from 26 to 54. A 1978 evaluation concluded that IRRI had performed extremely well, but that because the project had been in full operation for only 1½ years, there had not been sufficient time to train local personnel to carry on the work begun under IRRI's guidance.

Therefore, early in 1978, AID's Asia Bureau agreed to take over responsibility for funding (US$1.4 million) and managing the project for 2 additional years. Its aim was to permit achievement of the original project objectives of encouraging local manufacturers to acquire the capability to design, produce, market, and distribute small-scale machinery for local use in Pakistan, Thailand, and the Philippines, as well as Indonesia beginning in 1979. The immediate beneficiaries were to be the manufacturers and their employees, while indirect beneficiaries would be the small farmers whose production methods would improve, whose yields would increase, and whose incomes would rise accordingly.

Indonesia was added to the project so that it could benefit more fully from the R&D activities and subsequent testing and evaluation carried on by IRRI through assistance to and encouragement of local manufacturers. Previously, IRRI had made only a nominal extension effort in Indonesia through a USAID-funded subcontract with the Government of Indonesia (GOI) Directorate of Food Crops Production (DITPROD), which resulted in three Indonesian manufacturers embarking on commercial production of IRRI-designed machines in 1976. When the Indonesia activity was expanded, it was decided to concentrate on the Outer Islands of West Sumatra, South Kalimantan, and South Sulawesi which experience seasonal labor shortages, because of a concern over labor displacement in Java. The main target area chosen was the district of Agam and the subdistrict of Bukittinggi, which was underpopulated (12 persons/square kilometer) and short of agricultural labor, with the result that field wages are roughly triple those in Central Java. Beginning in the spring of 1978, IRRI dispatched engineer V.R. Reddy to Indonesia to work with GOI counterparts to establish the project in these sites, as well as a GOI-funded site in South Sulawesi.

In 1980, an evaluation was conducted to assess the combined outcomes of the centrally funded (1975-1978) project and the Asia Bureau-funded (1978-1980) project continuation to determine whether AID should provide further support to the project.[2] The

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[2]Garrett Argento et al., "Evaluation of IRRI Small Scale Farm Equipment Project" (Washington, D.C.: Agency for International Development, 1980) (mimeo).

team concluded that AID funding should be continued for another 5 years, that the services provided by the Georgia Institute of Technology were not cost-effective, and that IRRI's core staff and country teams should assist in the preparation of more explicit country outreach strategies (including agreement on short- and longer-term objectives, criteria for the identification of target locations, more careful selection of machine types, more detailed plans for institutional and personnel development, and identification of social and economic consequences to be monitored). With regard to the Indonesia effort, the team concluded that the program had led a precarious financial existence and that it lacked both a strategy and adequate coordination. Initial successes were attributed more to the energy and resourcefulness of the IRRI representative, V.R. Reddy, than to overall planning, management, or support. Despite these shortcomings, in a few months, a permanent office and workshop for the IRRI-DITPROD industrial extension project had been established; prototypes of the TH-6 thresher, axial flow pump, and power tiller were fabricated; a short training program was conducted for IRRI-DITPROD engineers; and a pilot project was initiated in West Sumatra.

2. THE INDONESIA PROJECT

On the basis of the 1980 evaluation, the Asia Bureau decided to continue the project for another 5 years at a total cost to AID of US$4.35 million. Pakistan was dropped from the new project, whose purpose was to develop the small farm equipment industries of the Philippines, Thailand, Indonesia, and now India. It was believed that, by developing these industries, the following benefits would be obtained:

1. Establishment of a local capability to design, adapt, and produce appropriate mechanical technology for small farms

2. Greater small-farm productivity through more efficient use of labor, land, fuel, and other agricultural inputs

3. Greater small-farm income as a result of greater productivity and more time for off-farm employment

4. Creation of manufacturing employment in rural areas

5. Foreign exchange savings resulting from import substitution

It was argued that unlike development assistance extended strictly to the public sector, IRRI's concentration on the private sector would ensure that the prototype machinery it designed

and promoted would not be produced unless it proved profitable to both the producer and the buyer. Although this market test approach assumed that market forces in participating countries serve national interests, this aspect was considered to be a strong attraction of the outreach program. The IRRI machine that has consistently passed the market test in all participating countries is the axial thresher. In the relatively high-wage district of Bukittinggi in West Sumatra, comparisons of land preparation costs were made using manpower only, man plus bullock, the IRRI two-wheel tractor, and a small Japanese four-wheel tractor. Considerable savings were attributed to the IRRI tractor.

Under the new project, IRRI was to continue operating outreach offices from its Los Banos headquarters to stimulate the development of a viable, small farm equipment industry performing the following functions: research, testing and evaluation, extension, product development, manufacturing, marketing, and feedback. IRRI and the host country were to incorporate the functions most in need of development into country development strategy statements to serve as the basis for negotiating joint agreements, including work plans and yearly performance targets.

The Indonesia Strategy Statement/Work Plan (1980-1985) established the goal of enabling Indonesia to become self-reliant and self-sufficient in its requirements for small farm machinery and equipment. Broad objectives include the following:

1. Carrying out field extension work to create demand for locally made IRRI-type equipment

2. Identifying local, small workshops and providing them with technical assistance to manufacture and maintain the quality of this equipment

3. Institutionalizing this program by building up a cadre of young Indonesian engineers and technical assistants in a central office and in selected provinces, who are trained to design, adapt, build, and test prototypes of farm equipment and machinery suited to local conditions

4. Helping concerned GOI agencies to formulate and implement a long-range, national mechanization policy

Given limited project resources, it was decided to concentrate initially on a few sites that had experienced labor shortages and that had a potential for multiple cropping, and where some local workshops existed, local agricultural extension agents were active, and local banks or credit facilities were available. Thus, it was agreed to continue the concentration on West Sumatra, with supplementary activities in South Sulawesi and South Kalimantan. It was further agreed that the project would be evaluated not only according to the number of fabricators and

the equipment manufactured by them, but also according to the total number of persons trained and involved in the project work and the establishment of an effective industrial extension operation within the Ministry of Agriculture.

A late 1981 informal evaluation of the Indonesia activity found that excellent progress had been made in West Sumatra in equipment extension and the development of small-scale fabricators since the previous project evaluation roughly 2 years earlier.[3] From a base of almost no activity in the fall of 1979, five established fabricators built and sold 100 threshers, another dealer in the province sold 50 threshers manufactured in Java, and two new West Sumatran fabricators embarked on thresher production. With one possible exception, all of the initial West Sumatran fabricators were small businesses by Indonesian standards, some beginning operation with only a few hand tools.

The IRRI-DITPROD work plan for 1982-1985 summarized accomplishments during the period 1980-1982 as follows: (1) the number of manufacturers and implements manufactured increased substantially; (2) the staff at the IRRI-DITPROD workshop built, modified, and field tested 69 prototypes; and (3) two central and four provincial training programs were conducted. In addition, the AID Mission in Indonesia financed a comparative study in the Luwu District of South Sulawesi of imported mini-tractors and locally made (IRRI-type) hand tractors over a 2-year period. Study results showed that the locally made hand tractor was more economical and efficient. More than 50 farmers from two villages applied for loans for the tractors, and one manufacturer had been identified and assisted in manufacturing two IRRI-type machines.

Under the new work plan, field extension work now includes Central and West Java, as well as the provinces of West Sumatra, South Sulawesi, and South Kalimantan. Greater stress is being placed on the manufacture of hand tractors, trailers, reapers, transplanters, and axial flow pumps. Training activities, including seminars, are being continued.

Recent reports indicate that progress in South Kalimantan has been slow. Lift irrigation, paddy drying, and threshing have been priority activities in West Java. Overall, with the exception of axial flow pumps, the fabrication of IRRI-designed equipment has increased. Table B-1 provides information on IRRI-designed small-scale agricultural machinery fabricated in Indonesia through 1982/1983.

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[3]Garrett Argento et al., "Evaluation Report on Extension of Small Scale Agricultural Equipment (492-0265)" (Washington, D.C.: Agency for International Development, 1982) (mimeo).

Table B-1. IRRI-Designed Small-Scale Agricultural Machinery Fabricated in Indonesia through 1982/1983

Province	No. of IRRI Coop. Mfrs.	Hand Tractors	TH-6 Threshers	Water Pumps	Other
W. Sumatra	14 + 1[a]	4	300	3	-
S. Sulawesi	3 + 1[a]	5	3	2	-
S. Kalimantan	3	2	8	40	-
Java	7 + 1[a]	85	265	260	4[b]
Total	27 + 3[a]	96	576	305	4[b]

[a]Government workshops, such as the IRRI-DITPROD workshop in Jakarta and the one in Bukittinggi.

[b]Two reapers and two transplanters, produced at the Pasar Minggu Workshop.

APPENDIX C

METHODOLOGY

The team focused on the International Rice Research Institute (IRRI) and its Government of Indonesia (GOI) counterparts within the larger context of Government policy regarding agricultural mechanization and small-scale enterprise development. Interviews with USAID/Jakarta staff and consultants, the GOI, and nongovernmental organizations were conducted to gain an understanding of these issues. The team concentrated its efforts on studying small manufacturers of IRRI-type equipment. Some are formal project cooperators; others are not. A prior stop at IRRI headquarters in Los Banos, Philippines afforded an opportunity to

ino project cooperators to pretest questions.

The fact that the team used an active project as its entry point to small-scale manufacturers affected both its mobility and access. IRRI officials and their GOI counterparts (assisted by USAID/Jakarta) scheduled site visits and interviews, and they accompanied the team throughout. This imposed some limitations on the objectivity of the study. However, because the GOI is not predisposed toward evaluations, Government sanction (and participation) was unavoidable. Furthermore, the fact that the team was accompanied by IRRI and GOI project personnel afforded it access to areas where it would otherwise have been difficult, if not impossible, to travel and provided the team with an opportunity to observe IRRI and GOI officials as they functioned in their technical assistance roles. These benefits more than offset any loss in objectivity.

Time did not permit the team to visit all four areas in which the AID project is directly involved. Therefore, after an initial series of meetings in Jakarta and visits to two larger manufacturers of IRRI-type equipment there, we visited nine fabricators in West Sumatra, the province in which IRRI and the GOI concentrated their its initial efforts. This was followed by visits to North Sumatra and Aceh Provinces, nonproject areas where IRRI-type equipment is taking hold and where local manufacturers are assisted by national and provincial governments. A second trip to West and Central Java included visits to several larger project cooperators, as well as the Government's Metal Industry Development Center in Bandung, a nongovernmental organization in Yogyakarta, a mini-industrial estate in West Java, and Kubota subcontractors in Klaten. In all, the team visited 24 manufacturers of IRRI-type equipment and provincial workshops.

The four-person team spent 2 days at IRRI-Los Banos, where it was briefed on IRRI's long-term effort to develop small-scale agricultural machinery and to extend the technology. Two manufacturing enterprises that are cooperators with the IRRI industrial extension effort in the Philippines were visited. A series of meetings and interviews was held prior to and following the site visits.

Information from these meetings was supplemented with secondary source materials. A partial listing appears in the Bibliography.

Visits were conducted over a 2-week period to 21 small fabricators and 3 larger manufacturers of agricultural machinery. They are located in Jakarta and the provinces of West Sumatra, North Sumatra, Aceh, West Java, Central Java, and Yogyakarta. The fabricators were interviewed, using a matrix checklist, to elicit information on the firm's history, owner, technical assistance/training received, production, innovations, and marketing/sales. The fabricators' plants, equipment, manufacturing processes, and products were observed. The following is a list of the small fabricators and three larger manufacturers of small-scale agricultural machinery visited by the team:

1. Fa. Tugas--Jakarta Timur
2. New Ruhaak Indonesia--Jakarta Kota
3. Bengkel Family--Padang Pariaman, West Sumatra
4. Dragon--Sungai Sarik Pariaman, West Sumatra
5. Kilang Minyak Cooperative--Sungai Sarik Pariaman, West Sumatra
6. Tumbok Jaya--Lubuk, West Sumatra
7. Diperta Workshop--Bukittinggi, West Sumatra
8. Sarasah--Bukittinggi, West Sumatra
9. Altan--Bukittinggi, West Sumatra
10. DSM--Bukittinggi, West Sumatra
11. Urra--Singai Puar, West Sumatra
12. Kasim--Pandang, West Sumatra
13. Cipta-maju--Perbaungan, North Sumatra
14. Sahabatini--Tanjunmorawa, North Sumatra
15. HGM--Perusahaan, North Sumatra
16. Diperta Workshop--Medan, North Sumatra
17. Simbolon--Medan, North Sumatra
18. Diperta Workshop--Banda Aceh, Aceh
19. Komera--Banda Aceh, Aceh
20. Abadi Teknik (LIK)--Sukabumi, West Java
21. MIDC Workshop--Bandung, West Java
22. Kopo Metal--Bandung, West Java
23. Kubota Indonesia--Semarang, Central Java
24. Karya Hidup Sentosa (Quick)--Yogyakarta

During the period of site visits, visits were also made to MIDC in Bandung, to a mini-industrial estate south of Bogor, and to Yayasan Dian Desa, a nonprofit organization in Yogyakarta.

A final week in Jakarta was spent in drafting the report and conducting exit meetings with Government, USAID/Jakarta, and IRRI officials.

APPENDIX D

BACKGROUND AND POLICY ENVIRONMENT

This appendix is directed toward readers who are unfamiliar with the Indonesian scene. It provides information on the policy and program context within which the effort to promote the manufacture and use of small-scale agricultural machinery is taking place.

1. MACROECONOMIC TRENDS AND POLICY

Paralleling the worldwide recession, the Indonesian economy has been slowing down during the 3-year period FY 1980/1981 to FY 1983/1984. Growth in real GDP fell from 9.9 percent in 1980/1981, to 7.9 percent in 1981/1982, to 2.2 percent in 1982/1983, and will probably be about 2 percent in 1983/1984. After averaging 4.4 percent real growth for the period 1977-1981, agriculture grew by only 1.8 percent in 1982 and was not expected to do better in 1983. Rice production grew by 4 percent in 1982, but less than 0.5 percent in 1983, after averaging a 9-percent growth rate for the 4 preceding years. Drought, along with the general economic slowdown, has affected agricultural growth rates.

In the face of the recession, the Government of Indonesia (GOI) has undertaken a variety of broad policy changes; even more important, it has recognized that the period of oil-based rapid economic growth is over. In 1982, domestic oil prices were increased by 60 percent, Government salaries were frozen, and a number of actions were taken to shift from an import-substitution to an export-promotion policy. Credit policy was tightened.

In 1983 an austerity budget was adopted, the Government wage freeze continued, the rupiah was devalued by 28 percent, State banks were given discretion to set deposit and most lending rates, regulations affecting the private sector were simplified, and taxes were reformed. In early 1984, domestic petroleum prices were increased again by an average of 45 percent.

These policy efforts, which are generally applauded by international experts, should lead to a gradual economic recovery.

2. OVERVIEW OF THE AGRICULTURAL CONTEXT

Although plantation crops, such as rubber, coffee, and sugar, have a significant place in the economy of Indonesia, rice is the single most important crop and the main crop of the vast majority of farmers. Moreover, rice production is the focus of this study of the effort to promote the manufacture and use of small-scale farm machinery developed by IRRI to assist in increasing paddy yields.

Differences in rural population density are an important consideration. Population densities are extremely high in Java, Bali, and Madura, but relatively low in the Outer Islands, including Sumatra. The consequent large variation in labor availability per hectare of cultivated land has important implications for the appropriateness and adoption of mechanization.

Changes in rural Indonesia during the last 50 years are listed below. Although these trends are most pronounced in Java, they also apply to the rest of the country, although perhaps to a lesser degree.[1] The changes include the following: (1) the number of landless has increased greatly; (2) the average size of farm operations has declined; (3) the number of large farm operations has declined; (4) the number of people migrating, both permanently and seasonally, has increased; (5) in real terms, wage levels have remained relatively the same; (6) the price of land has increased greatly; (7) opportunities for work outside of the villages have increased significantly; (8) the use of purchased inputs has increased greatly; and (9) the distribution of land and income is much less equitable than in the past.

These trends, which may have accelerated during the last decade, have not had an adverse affect on total rice production, which has more than doubled in the last 20 years. Previously the world's largest importer of rice, Indonesia is now essentially self-sufficient in good years. This has been achieved by improved water control, enabling cropping intensities of above 2.0, and the use of high-yielding seeds, fertilizer, and modern crop protection methods. Rice production also has been stimulated by relatively rapid increases in rice prices in relation to the costs of major inputs such as fertilizer and labor.

At present, most rice is produced on individual small owner-operated or tenant farms. About one-third of these belong to

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[1] W. Collier, "Improving Cropping Patterns, Labor Absorption and Small Farm Mechanization in Indonesia" (Los Banos, Philippines: IRRI, 1981) (mimeo).

Government-sponsored cooperatives, which have not been very successful. Most rice is either consumed on the farm or sold locally; BULOG (the national rice procurement agency) purchases only 5-10 percent of the domestic rice crop.

3. AGRICULTURAL MECHANIZATION OF SMALLHOLDER RICE PRODUCTION IN INDONESIA

Aside from rice milling, most aspects of rice production use traditional methods. Most land is prepared for planting by men using large hoes or draught animals harnessed to plows. During the last decade, mechanized land preparation has started to increase; however, it still accounts for only a small proportion of land preparation. Seeding, transplanting, and fertilizing are virtually all done by hand. Around 1970, farmers started to transplant rice in straight rows to enable them to use simple, rotary weeders. The weeders are now used widely throughout the country. Women used to do the weeding by hand; now men do it with weeders in less than half the time.

Almost all rice is harvested by hand. However, there has been a major improvement in the implements used. The hand-held knife (ani-ani) has largely been replaced by the sickle, which began to be used widely in the early 1970s. The adoption of the sickle increased productivity by 50-100 percent. It also led to the formation of groups that do contract harvesting. Threshing and winnowing also are still done largely by hand. However, labor shortages at harvest time and losses due to delayed threshing have led to the introduction of pedal- and machine-powered threshers in some areas. Still, less than 2 percent of Indonesia's annual rice crop is threshed or winnowed by machine.

Virtually all rice is dried in the sun. Mechanical dryers account for only a small fraction of rice dried. However, one of the important developments in rice production is the widespread adoption of small power hullers for rice milling. During the last 15 years, power hullers have replaced virtually all hand pounding. This has reduced milling costs by two-thirds and shifted the labor requirement from unskilled women to men with some mechanical skill. An estimated 1.2 million jobs have been lost as a result.

The relationship between agricultural mechanization and employment is an important issue. The Indonesian labor force is increasing by about 3.2 percent annually, and rural unemployment and underemployment are a serious problem in Java. Obviously, the mechanization-employment tradeoff varies between labor-surplus Java and labor-deficit areas such as Sumatra, Sulawesi,

and Kalimantan. The issue has important implications for agricultural mechanization policy. However, it is important to reiterate that this issue is not a focus of this report.

4. POLICIES AFFECTING AGRICULTURAL MECHANIZATION

The Third Five-Year Development Plan (Repelita III) for 1979-1984 includes a number of policies and programs affecting agricultural mechanization. Repelita IV (1985-1989) is expected to continue these policies and programs, while adjusting them to the evolving economic situation and the critical need for employment generation.

Repelita III gives high priority to the agriculture sector, including agroindustries. Its goals are (1) to increase farmer incomes, (2) to increase labor and land productivity, (3) to increase food crops, (4) to increase rural employment, and (5) to support regional development. These goals were to be achieved through four programs: intensive cropping, extensive cropping, diversification of crops, and rehabilitation of estate crops.

Specifically, Repelita III planned to introduce agricultural mechanization to develop new areas and increase production in labor-shortage areas. The policy implies that labor-displacing agricultural mechanization should not be encouraged in labor-surplus areas such as Java. Research and development focus on equipment that meets the physical and socioeconomic requirements of each area. New equipment is field tested and evaluated; producers and distributors are given training, technical advisory services, and spare parts.

Repelita III provides the following guidelines for the agricultural machinery industry: (1) to increase employment, (2) to produce equipment in response to demand, (3) to develop agroindustries, and (4) to decentralize the industry while maintaining its economic efficiency. As a result of Repelita III, considerable investment occurred during 1978-1981 in the domestic agricultural machinery industry. Domestic production expanded rapidly, particularly rice-milling unit. However, the worldwide recession resulted in a large drop in demand in 1982. Producers found themselves with large inventories and considerable excess capacity. To help the industry, the GOI recently banned the import of rice-milling units, hoes, hand sprayers, hand tractors, and portable threshers. This ban protects domestic producers by guaranteeing them 100 percent of the future market. However, some importers stockpiled large inventories before the ban went into effect, which has initially kept prices down. Furthermore, the lack of international competition might have a negative impact on the efficiency of domestic producers.

Although Repelita IV was still being finalized at the time of this study, it is clear from President Suharto's August 1983 State of the Economy speech that employment creation will be a major goal. He also said that the emphasis in agriculture will be on improving and expanding production for domestic consumption and export. Continued attention will be given to crop intensification, crop diversification, extensive cropping, rural employment, and food production. President Suharto also indicated that under Repelita IV, emphasis will be placed on production of industrial machinery, especially machinery for agricultural production and processing. Thus, it appears that the agricultural machinery industry will receive special attention. However, employment generation is still the major objective, and the mechanization-labor displacement debate is likely to continue.

5. POLICIES AFFECTING SMALL-SCALE MANUFACTURING ENTERPRISES

Small-scale manufacturing enterprises (of up to 19 employees) account for over 80 percent of manufacturing employment, but less than about 15 percent of the sector's total value added. Employment for small manufacturing enterprises more than doubled during the 1970s. It is interesting to note that employment in firms with fewer than 10 workers accounted for most of the growth.[2] Employment growth in rural areas was slightly greater than that in urban areas. Growth in Java was about 40 percent less than that on the Outer Islands. Unfortunately, real value added did not grow nearly as fast as employment. Thus, real value added per worker has declined considerably since 1970. Real wages declined as well.

In general, large enterprises in Indonesia have good connections with the GOI and are able to secure large Government contracts and other benefits. For example, the GOI recently ruled that all scrap iron must be sold to the giant Krakatua Steel Company, a decision that will reduce the supply and raise the price of this basic raw material for manufacturers of farm implements. The GOI bias toward larger enterprises is partially offset by Government policies that emphasize the development of small pribumi (indigenous Indonesians) enterprises. A variety of GOI programs and regulations address this objective, including credit (see Section 6), technical assistance and training,

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[2]Donald R. Snodgrass, Small-Scale Manufacturing Industries: Patterns, Trends, and Possible Policies, Development Discussion Paper No. 54 (Cambridge, Massachusetts: Harvard Institute for International Development, 1979).

Government procurement policies, and preferred licensing.[3] While the policies are supportive, they are subject to considerable reinterpretation at the local level, leading to certain ambiguities.

A variety of enterprise development services, such as technical assistance, training, credit, and marketing, is provided by the Ministries of Industry, Trade, Cooperatives, and Labor, as well as by universities, technical institutes, banks, and nongovernmental organizations. General problems that cut across these services include the following:[4]

1. Lack of coordination among various service providers, leading to service duplication and inefficient use of resources
2. Too few qualified personnel to plan and effectively carry out these programs
3. Top-down planning, which often leads to the provision of inappropriate services
4. Apparent difficulties in delivering needed services to the private sector
5. Gaps in the types of services available
6. Insufficient funds to carry out projects as planned
7. Lack of incentives or linkages to foster direct firm-to-firm support
8. "Single factor" solutions to complex, multifaceted enterprise development problems
9. A general failure of the public sector to provide sufficient services on time and in a cost-effective manner

Despite these problems, GOI policies and various service programs are having a positive effect on the development of many small manufacturing enterprises, including the fabricators of small-scale farm machinery.

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[3]Development Alternatives, Inc. (DAI), Central Java Enterprise Development Project (Design) (Jakarta, Indonesia: USAID, 1983).

[4]DAI.

6. CREDIT

Rural Indonesians have a savings propensity of about 20 percent, suggesting that ample credit should be available. However, most savings are held in paddy stocks, gold, and land and thus are not available to borrowers for investment purposes. This savings pattern results from limited access to financial institutions and the negative real deposit rates offered by such institutions. Thus, the supply of credit is somewhat limited, and effective interest rates are usually high.

Nonetheless, a wide variety of formal and informal credit sources are available to the producers and users of small-scale agricultural machines.

6.1 Formal Credit Sources

Under the aegis of Bank Indonesia, a number of State banks focus on specific sectors such as industry, mining, estate agriculture and forestry, export promotion, and rural development. The Bank Rakyat Indonesia (BRI) focuses on small farmers, fishermen, cottage industries, petty traders, and cooperatives. It is the primary formal credit institution to which small farmers may turn for loans to purchase farm machinery. The Bank National Indonesia 1946 (BNI '46) makes industrial loans to small farm machinery manufacturers.

BRI is the largest and most important formal banker for the rural sector. At the end of 1981, it had 284 regional offices and 3,610 village units. Its operations have expanded rapidly; average growth of credit has been about 20 percent per year since 1975. By 1980, it held 20 percent of all outstanding bank loans and had extended credit to over 30 percent of rural households.

Village units handle loans under the Bimbingan Massal (BIMAS), Kredit Investi Kecil (KIK), and Kredit Modal Kerja Permanen (KMKP) programs. During the 1970s, the BIMAS program to encourage intensive rice production was the largest BRI activity. However, repayment rates deteriorated for several reasons, including frequent moratoriums granted by the GOI to farmers. Many farmers are presently ineligible for any BRI loans because of defaults on prior BIMAS loans. BIMAS, a highly subsidized and losing proposition for BRI, has declined in recent years and is being replaced by other programs.

The new KUPEDES general rural credit program probably will replace BIMAS, as well as other credit programs. KUPEDES is attractive to regional and village banks, because it plans to charge realistic interest rates of 1 percent per month for

investment loans and 1.5 percent per month for working capital, based on the initial balance. This means effective rates will be about double the nominal rates, or roughly comparable to informal credit (25-40 percent annually). The loans will require land as collateral and have an initial limit of about US$1,000. It is anticipated that KUPEDES will be a major source of institutional credit for farmers wishing to buy small-scale agricultural machinery.

Some provincial banks have already established programs roughly comparable to that of KUPEDES. The best known of these is Badan Kredit Kecamatan (BKK), which was started in 1972 by the Central Java provincial government. It provides small, short-term loans primarily to rural families for off-farm productive purposes. BKK, which is supported by AID, operates like some informal credit operations. It charges 3.3-percent interest per month, relies on character references, reduces risk by making small initial loans followed by repeat loans, and is very decentralized. The average loan amount is less than US$200. Potentially, an entrepreneur could use a BKK loan to buy a thresher and start a custom-hire business. It is a successful program that has expanded rapidly.

KIK and KMKP were started in 1974 to provide financing to small-scale, labor-intensive enterprises owned by pribumi. KIK provides loans for fixed assets; KMKP supplies working capital. They have grown very rapidly. In addition to BRI, which handles about half of all KIK and KMKP loans, a number of other banks are involved, including BNI '46. The project itself serves as collateral for KIK and KMKP loans. The maximum first loan is US$10,000; if repaid on schedule, second loans of up to US$15,000 are available. KIK loans are normally for 10 years at 12 percent, with a 4-year grace period. KMKP loans are for 3 years at 12 percent, with a 1-year grace period. About 10 percent of KIK and KMKP loans go to industry, including fabricators of small farm machines; other loans go to agriculture, trade, transportation, and other sectors.

The demand for GOI-subsidized loans greatly exceeds the supply. Despite recent efforts to streamline the programs, they still have high transaction costs and involve considerable red tape. Because of the level of the subsidy, bankers select borrowers to suit their own official or unofficial interests. As a result, the actual (unofficial) interest paid by borrowers is usually much higher than nominal rates, often approaching comparability with informal sources of credit.

6.2 Informal Credit

Although good data are not available, evidence suggests that informal credit is the major source of borrowing for rural households and small rural enterprises. These systems charge relatively high interest rates, rely on personal relationships, and have relatively low transaction costs. Processing is usually rapid.

Six types of informal credit are available:

1. Moneylenders provide credit at rates varying from 3 percent per month to 10 percent per day.

2. Savings associations (Arisan) allocate loans by lottery, bidding, or according to a predetermined order; villagers contribute savings to savings associations at regular intervals.

3. Savings and loan associations set credit limits according to the amount of each member's savings. Interest on savings is generally about 3-5 percent per month; interest on loans, however, may be as high as 60 percent per month.

4. Traders and suppliers often buy and sell on installment. Calculation of interest rates is difficult and the rate is not usually stated, and commodities are priced above the price paid for cash transactions. The implied credit rate is roughly 10-15 percent per month. This form of credit is well suited to fabricators who may pay for inputs such as engines on installment and receive installment payments for their farm machines.

5. Labor group members deposit part of their wages in a common fund that is used for group enterprises or to purchase capital equipment to increase their productivity. For example, a contract threshing group might pool part of its wages to purchase a thresher.

In conclusion, there is a variety of formal and informal credit systems, and each performs an important and useful financial role, although some may be exploitative. Competition from formal credit systems serves to reduce interest rates in the informal sector. Both systems are potentially available to provide the credit needed to establish and operate a small-scale agricultural machinery fabrication enterprise or to purchase a machine.

APPENDIX E

MINISTRY OF INDUSTRY PROGRAMS FOR PROMOTING THE DEVELOPMENT OF DOMESTIC SMALL-SCALE INDUSTRIES

The Ministry of Industry is one of several Government of Indonesia (GOI) organizations tasked with promoting the development of small-scale industry. The Ministry's extension program--BIPIK--assists small industries at the provincial level with technical assistance and the provision of equipment. One IRRI-DITPROD cooperator, a West Sumatran blacksmith, has been assisted by BIPIK. Extension workers encouraged him to convert to thresher production; he has expanded his product line to include the production of poultry feeders, weeders, cane presses, and a rice mill, in addition to threshers. BIPIK mily in securing a bank loan to purchase equipment aining for the owner at the Government workshop in Bukittinggi.

Since 1979, the Government has encouraged the expansion of subcontracting arrangements among private suppliers, merchants, and Government institutions. This program is commonly referred to as Bapak Angkat or the Foster Parent Program. Parent firms engaged in subcontracting are identified and recognized officially by the GOI as Bapak Angkat. It is expected that they will assist subcontractors as necessary (e.g., in securing raw materials, technical assistance, and credit and in marketing). One large firm visited by the team, Kubota Indonesia in Semarang, is a model Bapak Angkat. Kubota Indonesia contracts locally for parts, purchasing from 25 to 30 suppliers, including many in the village of Klaten. This practice helps Kubota Indonesia meet GOI requirements for local components. Suppliers report that they are pleased with the relationship, although they would like to increase their sales to Kubota Indonesia and to be placed on a more regular schedule for deliveries.

More recently, the Ministry of Industry embarked on a program to develop mini-industrial estates, Linkungan Industri Kecil (LIK). Under this program, firms, including one thresher manufacturer visited in Sukabumi, West Java, are given access to Government-constructed workshops and are assisted by the estate manager in securing raw materials and in marketing their products. At the LIK site in Sukabumi, a Ministry of Industry staff of 25 assists 21 small manufacturers.

Finally, the Ministry of Industry's Metal Industry Development Center (MIDC) at Bandung plays an important role in

assisting small metalworking industries, principally in Java. It was established in 1970 to improve the quality and productivity of small firms through research and dissemination of technology. Its current program is focused on the production of rice-milling units and other agricultural machinery and implements that may no longer be imported. In the past, MIDC worked on IRRI-type machines; for instance, they tried to improve the power tiller transmission. They also assist IRRI-DITPROD with technology transfer, most recently at the 2-week power tiller course at the Bukittinggi workshop.

MIDC's own training programs are geared toward BIPIK extension workers who receive 3 months of initial training in Bandung, followed by specialized training after a minimum of 6 months of work experience. Other extension workers, including Ministry of Agriculture field personnel, may attend these courses on a cost-reimbursable basis. However, budget constraints limit training opportunities to 28 participants each, 4 times a year. The budget also limits the onsite assistance and training that MIDC field personnel may supply. Despite its limited staff and underutilized workshop, MIDC is generally well regarded. One IRRI cooperator in Bandung received an MIDC training fellowship and reported that he regularly receives technical advice from MIDC experts.

MIDC has been the recipient of substantial foreign assistance. Since 1970, the Belgian Government has provided large amounts of sophisticated machinery to the MIDC workshop, along with technical assistance and training fellowships. In 1975-1976, UNIDO provided assistance in production development, and the Germans supported production management activities from 1976 to 1982.

APPENDIX F

THE SUBDIRECTORATE FOR AGRICULTURAL MECHANIZATION

DITPROD's Subdirectorate for Agricultural Mechanization has developed a strategy for selective agricultural mechanization in targeted areas. To determine its priorities for promoting the manufacture and use of small-scale agricultural machinery, the Subdirectorate has categorized the country in the following terms:

I. Regions ready to adopt small-scale mechanization, including

   A. Those where mechanization will sell itself (self-starting)

   B. Those where extension is necessary

II. Regions where there are constraints to introducing mechanization

III. Regions where mechanization is not appropriate

The attached flowchart (Figure F-1) was prepared by the Subdirectorate to describe implementation of the strategy in terms of a 5-year activity plan for "selective mechanization in targeted areas." The second chart (Figure F-2) emphasizes decision points, the need to popularize the machinery with both farmers and small industries, and iterative feedback to research; it uses the same Roman numerals and letters as above to designate the Subdirectorate's priorities for promoting the manufacture and use of small-scale agricultural machinery.

The provincial budget allocations, shown in Table F-1, confirm these priorities, not only in the provinces' contributions to the mechanization program, but also in the comparison of US$/hectare of harvested paddy.

Figure F-1. DITPROD Strategy for Selective Agricultural Mechanization

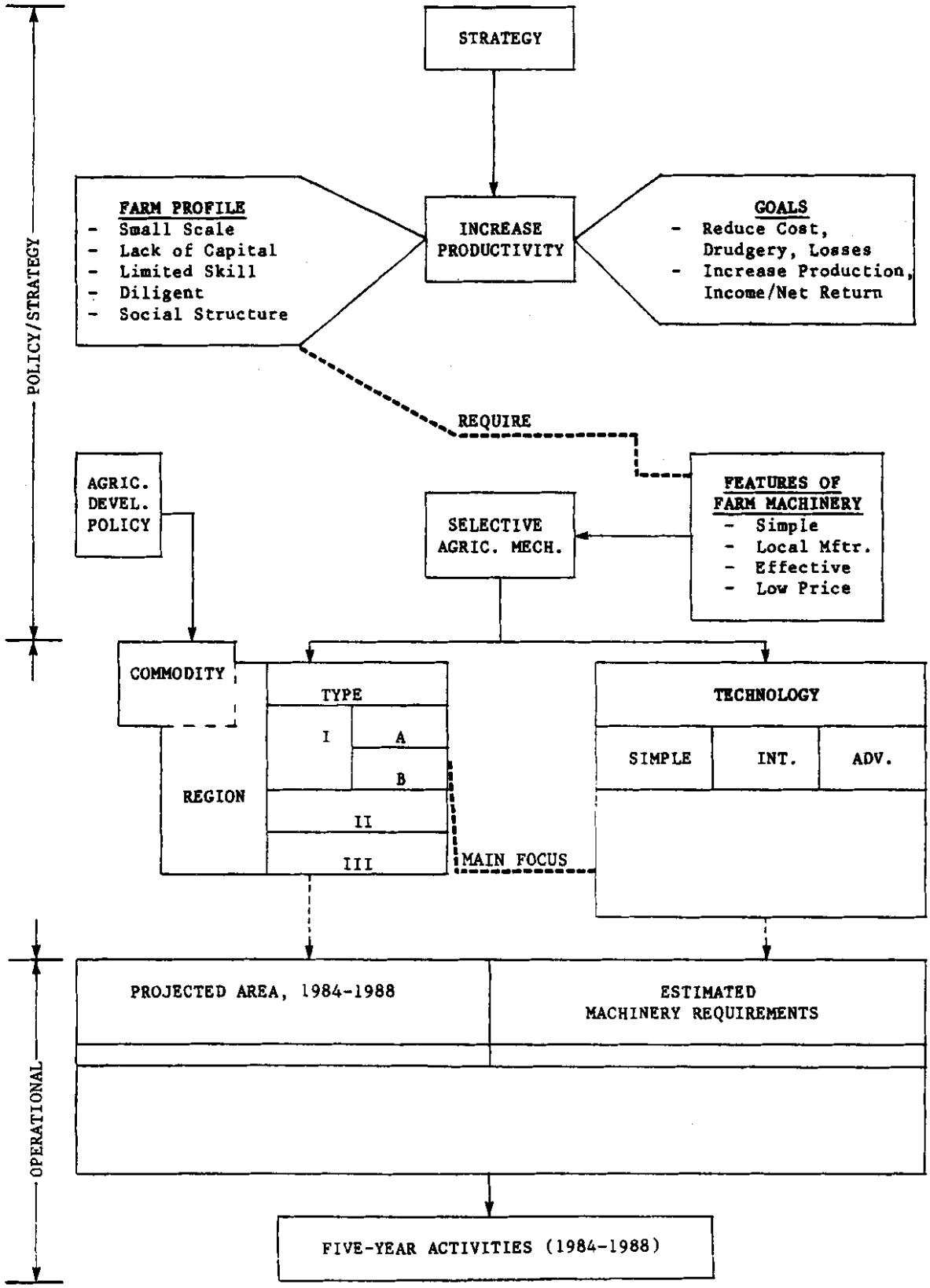

Figure F-2. DITPROD Agricultural Mechanization Activities, 1984-1988

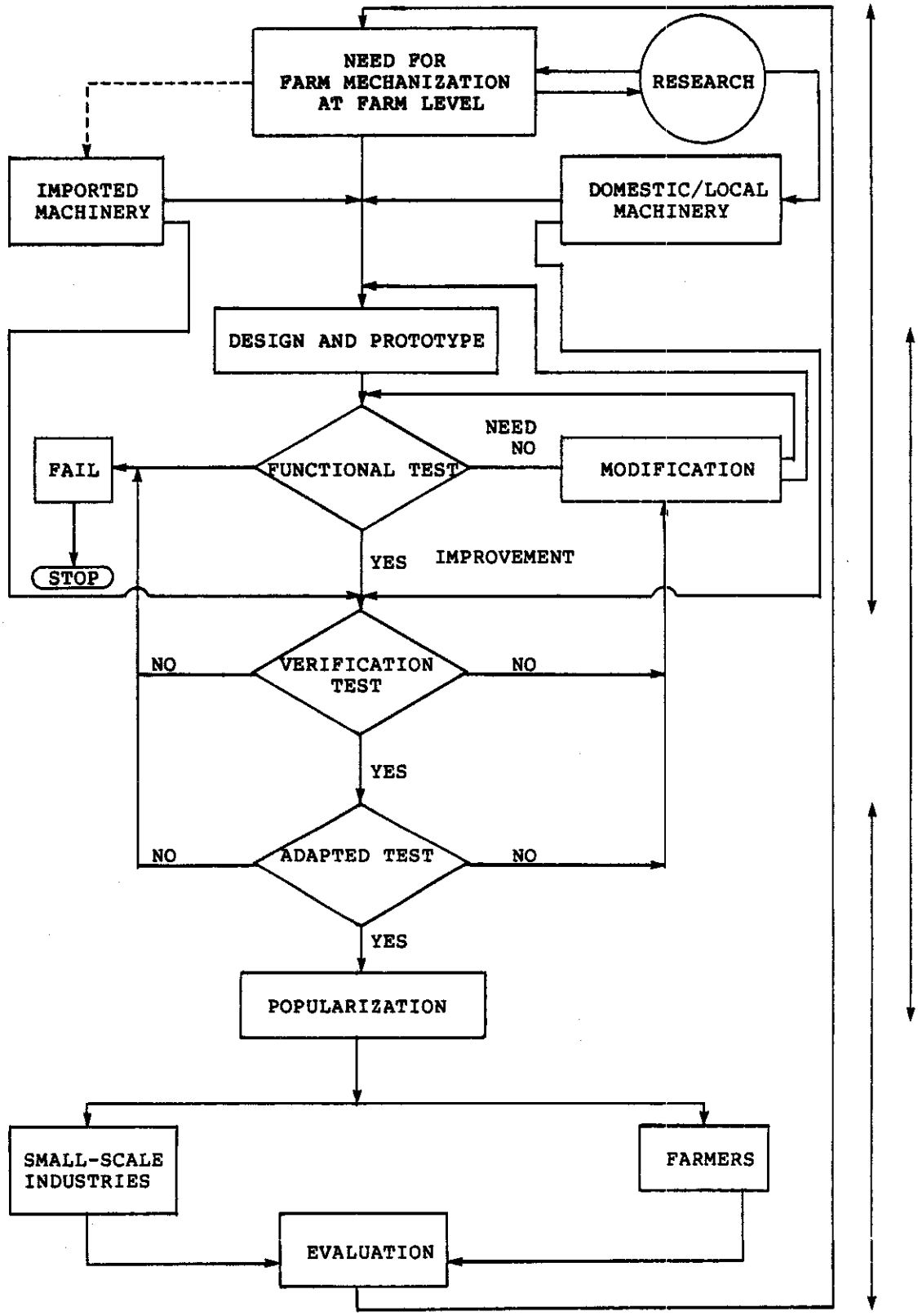

Table F-1. Provincial Budgets for Agricultural Mechanization, 1984/1985

Province	Dollars[a] (000)	Harvested Paddy (US$/hectare)
Sumatra		
Aceh	19.4	78
North Sumatra	42.0	74
West Sumatra	66.6	228
East Sumatra	22.1	164
Jambi	24.1	169
Bengkulu	29.1	460
South Sumatra	34.3	93
Lampung	31.6	110
Java		
Jakarta	6.7	420
West Java	66.0	34
Central Java	49.1	35
Jogjakarta	48.6	322
East Java	44.7	30
Kalimantan		
West Kalimantan	19.7	65
Central Kalimantan	18.7	157
South Kalimantan	60.1	181
East Kalimantan	15.1	190
Sulawesi		
North Sulawesi	25.9	371
Central Sulawesi	15.0	128
South Sulawesi	61.9	104
Sulawesi Tenggara	19.4	539
Bali		
Bali	44.8	256
Nusa Tenggara Barat	48.7	209
Nusa Tenggara Timur	12.5	94
Other		
Maluku	10.3	459
Irian Jaya	10.3	na
Timor Timur	1.7	na
Total	848.3	Average 90

[a]US$1=Rp992 in February 1984.

APPENDIX G

MANUFACTURERS' MODIFICATIONS TO IRRI-TYPE FARM MACHINERY

Structural Changes to Threshers

1. Weight reduction
2. Concave shape
3. Engine mount/idler pulley
4. A-frame structural supports
5. Horizontal rather than slanted lid
6. Wheels for transport
7. Solid cast drum ends
8. Open drum for access to teeth
9. Safety shields for pulley
10. Screen material reinforcing

Performance Characteristics Altered

1. Increased capacity, drum speed
2. Increased cleaning
   -- Blower housing shape and adjustments
   -- Screen spacing
   -- Cam-operated shaker tray
3. Reduced clogging
   -- Shields around drum ends
   -- Breaker teeth changes
   -- Straw-kicker design

Fabrication and Manufacturing Process

1. Substituting purchased screen for wire rod fabrication
2. Casting end drums
3. Straw-kicker design
4. Riveting guide vanes in concave
5. Mode of fastening teeth
6. Hold-downs for concave
7. Substituting heavier concave ends for structural braces

Modifications Aimed at Salability

1. Adjustable cleaning louvres
2. Wheels for transport
3. Safety shields

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